3.0 EXISTING CONDITIONS

The following discussion is a brief summary of the existing physical, ecological, and socio-economic conditions within the study area. It does not attempt to provide comprehensive coverage of all resources or concerns; rather its purpose is to provide a summary account of the baseline resources which are present in the study area and which may be affected by implementation of the Northwest Miami-Dade County Freshwater Lake Plan.

3.1 Location

The Lakebelt study area is situated in southeast Florida, in the northwest area of Miami-Dade County. The area is generally bounded by the Everglades/Krome Avenue to the west, the Florida Turnpike to the east, the Miami-Dade / Broward County line to the north, and Kendall Drive to the south. The study area encompasses approximately 57,515 acres. Refer to Figure 1 for precise boundaries of the study area.

3.2 Climate

The study area has a generally subtropical climate, characterized by long, hot, humid and wet summers followed by mild, dry winters. The wet season extends from May to October, while the dry season occurs from November to April (Thomas, 1974). High humidity, intense solar radiation, and unstable atmospheric conditions that result in frequent local thunderstorms, often accompanied by intense rainfall of short duration, characterize the wet season. Severe tropical storms can also occur during the wet season. Large amounts of rain can fall over localized areas in a short period of time and can result in extended periods of flooding.

The dry season is characterized by mild, dry weather. Frontal storms dominate the weather during the dry season often bringing cool, sometimes freezing temperatures, and rainfall of moderate amount and low intensity. Severe weather can accompany some fronts, bringing thunderstorms, tornadoes, and large amounts of rainfall. Thunderstorms that are not associated with fronts are possible in the dry season, but are relatively infrequent compared to the wet season.

Mean annual temperature for the region ranges from 72°F (22°C) in the northern Everglades to 76°F (24°C) in the south (Thomas, 1974). Mean monthly air temperatures range from a low of 63°F (17°C) in January to a high of 85°F (29°C) (Thomas, 1970). Infrequently, freezing temperatures and frost occur when arctic air masses follow winter cold fronts into the area.

3.3 Rainfall

On the average, south Florida receives about 53 inches (135 cm) of rain annually, 75 percent of which falls in the wet season (Shih, 1983). During the dry season, precipitation is governed by large-scale (synoptic) winter weather fronts which pass through the region roughly every seven days (Bradley, 1972). Rainfall from these fronts exhibits a more uniform distribution across the Everglades as compared to rainfall derived from the highly variable convection-type thundershowers that occur during the wet season.

Since records have been kept, annual rainfall in the Everglades Protection Area has ranged from a low of 37 inches (94 cm) in 1961 to a high of 106 inches (269 cm) in 1947. Typically, annual values vary from 40 to 65 inches (102 to 165 cm) with a mean annual rainfall over the Everglades of 51 inches (130 cm) (MacVicar and Lin, 1984). Within the EPA the greatest average annual rainfall occurs in the EAA and in ENP. The lowest average annual rainfall occurs in WCA-3A (MacVicar, 1983; Sculley, 1986). Besides the annual cycle, ranked patterns are associated with a 5-6 year cycle associated with global climate cycles (Davis and Ogden, 1994).

3.4 Wind

Winds are persistent year round, but on average, are strongest in the late winter or early spring (March). During the wet season, the prevailing winds are easterly. In the dry season, wind direction is variable. Wind movement is greatest during the winter when cold fronts move through the area.

3.5 Tropical Cyclones

Maps of storm paths between 1871 and 1981 show that 138 tropical storms and hurricanes crossed or came close enough to south Florida to have likely affected the Everglades ecosystem (Newmann et al., 1981). The coastal areas feel the effects of tropical storms more strongly than the noncoastal areas. Coastal damage results mostly from storm surges, which seriously erode or flood areas. Non-coastal damage results mostly from heavy rains and strong winds.

3.6 Evapotranspiration

Evapotranspiration (ET) is the combined process of evaporation from land and water surfaces and transpiration from plants. It is the means by which the bulk of the rainfall in the area is returned to the atmosphere and plays a major role in the climate of the Everglades. This process is estimated to remove between 70-90% of the rainfall in undisturbed south Florida wetlands (Duever et al., 1994). Evaporation from open water surfaces peaks annually in the late spring when temperatures and wind speeds are high and relative humidities are low. Evaporation is lowest during the winter when the temperatures and wind speeds are low (Duever et al., 1994). The depth to the water table and type of vegetative cover are also important in determining the amount of ET losses. Where the water table is close to the land surface, evaporation from the soil is

increased by capillary rise of moisture, and is about the same as evaporation from an open body of water. Lake evaporation in south Florida ranges from about 50 to 54 inches per year (in/yr).

Jackson and Maurrasse (1976) made water budget studies of selected quarry lakes. In one lake in northern Miami-Dade County, 49 feet deep, with a surface area of 6,741,000 square feet, they determined a storage volume of approximately 2.5 billion gallons of water, compared with about 0.5 billion gallons in the original rocks. This represented a gain in storage of about 2.0 billion gallons for the lake. For an assumed annual lake evaporation of 51 inches, total evaporation losses were only about 210 million gallons. The authors also indicated that over the long term, average rainfall should largely compensate for lake evaporation losses. Even for short term annual rainfall deficits (periods of drought) of 5 to 6 inches, the gain in net storage would still be approximately 1.8 billion gallons or more than 5 times the original storage in the rock.

The 1994 map of existing vegetation cover types of the Lakebelt area shows that the study area consists of large patches of the invasive non-native phreatophyte Melaleuca (*Melaleuca quinquenervia*) (figure 2). Unfortunately, there is presently very little information available regarding the evapotranspiration rates of melaleuca. For Hydrological studies presented in this EIS (Section 3.8 or refer to **Appendix A**), the recent report on ET rates of melaleuca (Chin, 1996) was used to select appropriate parameters for modeling melaleuca ET in both the regional model and the MODFLOW model. The method includes two factors for determining melaleuca losses in the lakebelt region. First, Chin (1996) calculated the actual evapotranspiration rates for melaleuca utilizing the Penman-Monteith method. In addition to the Penman-Monteith ET rates calculated for melaleuca, Chin (1996) suggests that a second component be added which accounts for evaporative losses due to interception of rainfall within the melaleuca canopy. It is assumed that these interception losses are removed from the system during heavy rainfall events and not available as recharge to the aquifer or for utilization by the vegetation. In order to determine the interception losses, Chin (1996) utilized Woodall's (1984) empirical equation for estimating interception losses. The result is that Chin (1996) determined that the maximum ET rate for melaleuca is approximately 51 in/yr plus an interception loss of approximately 12 in/yr resulting in a total loss of 63 in/yr.

Open water evaporation rates utilized in the Lakebelt model were also derived from data presented in Chin's (1996) report. Chin (1996) calculated open water evaporation rates utilizing the Penman-Monteith method and determined that the evaporation rates for open water in the Lakebelt region is approximately 63 in/yr or very similar to the potential ET rate for melaleuca.

At first glance, it would seem that the ET rates for melaleuca and open water are essentially the same and, therefore, the change from melaleuca forest to open water systems should have minimal impact in the overall water balance for the region.

However, this is not the case. The reason is the time variant nature of ET and rainfall in south Florida and how that impacts these two very different systems.

The lake systems are large open water bodies directly connected to the Biscayne aquifer. Because of this, rainfall, which falls on the lake system directly, recharges the Biscayne aquifer. However, rain does not occur constantly and there are extended periods of time when the lakes are evaporating with no rainfall to offset the losses. Because the lakes are directly connected to the Biscayne aquifer, the lakes will evaporate at 63 in/yr from the Biscayne aquifer regardless of the amount of rainfall.

On the other hand, the total losses from the melaleuca forest are a combination of interception losses during rainfall events and ET from the melaleuca plants (Chin, 1996). In this case, when it does not rain for an extended period of time, the maximum ET rate for melaleuca is about 51 in/yr, which is less than the 63 in/yr for the lake system. The actual ET rate from the Biscayne aquifer for melaleuca would tend to be less than 51 in/yr during the dry periods due to reduced water availability in the unsaturated zone for use by plants. The depth to the water table also can affect the ET rate. Melaleuca ET rates are assumed to start declining when the water table drops 18 inches or more below the ground surface.

3.7 Topography, Geology and Soils

The following section is a discussion of the topography, geology and soils of the Lakebelt region of southern Florida that determine, in conjunction with rainfall, evapotranspiration and other factors, the hydrologic framework and ultimately the ecological framework within the study area.

3.7.1 Topography

The Lakebelt area is topographically flat with elevations generally less than 20 feet (6 m) NGVD. The ground surface generally slopes from north to south with an average gradient of 0.15 feet/mile (2.8 cm/km) (Parker et al., 1955).

3.7.2 Geology

South Florida is a limestone platform that is partially under water. Four topographically high limestone physiographic features give rise to three shallowly covered limestone depressions. These depressions are, from west to east, the Everglades, the coastal bays, and the outer shelf depressions. The four limestone features include the Big Cypress Ridge, the Atlantic Coastal Ridge, the Key Largo Limestone Ridge, and the shelf-edge reefal ridge (Gleason and Stone, 1994).

The Everglades depression runs south from Lake Okeechobee down to the center of south Florida. To the west lies exposed Pliocene limestone--the Big Cypress Ridge. To the east lies a late Pleistocene quartz sand and oolitic limestone ridge--the

Atlantic Coastal Ridge. The Everglades depression carries fresh water southward from Lake Okeechobee to the seas just west of Florida Bay. Freshwater peat and calcitic mud deposits from the Holocene epoch fill the depression. Saline intrusion into the depression is regulated by a natural coastal dam of mangrove peat and storm-levee marl along channels such as Shark River Slough (Gleason and Stone, 1994).

The Coastal Bay depression is bordered on the landward side by the Atlantic Coastal Ridge and on the seaward side by the Key Largo Limestone Ridge. Freshwater marshes, mangrove swamps, and coastal storm levees and flats partially fill the Coastal Bay Depression. The Key Largo Limestone Ridge is submerged along the eastern margin of central and northern Biscayne Bay.

Nearly 20,000 feet (6,000 m) of predominantly shallow marine carbonate sediments underlie south Florida. The rock floor beneath the Florida peninsula is a truncated surface of various igneous and sedimentary rocks.

The formations that play a major role in the hydrologic cycle of the Everglades include the upper portion of the Hawthorn Group, Tamiami Formation, Fort Thompson Formation, Anastasia Formation and Miami Limestone, as well as undifferentiated surface soils and sediments. All of these lithologic units combine to form the Surficial Aquifer System in the Everglades region (Fish, 1988).

Hawthorn Group. Scott and Knapp (1988) divided the Hawthorn into two major lithologic units in south Florida: an upper unit of predominantly clastic material and a lower unit composed principally of carbonates. These two units are separated by a major unconformity. The Hawthorn may vary in thickness from 550 to 800 feet (170 to 240 m) within the Everglades Basin. It is composed of a heterogeneous mixture of green clay (calcareous and dolomitic), silt, phosphate, carbonates (limestone to dolomite), and fine quartz sand (Fish, 1988; Knapp et al., 1986). Although a few zones within this sequence may qualify as minor aquifers, Hawthorn sediments are relatively impermeable. The Hawthorn is important to the Everglades because it forms a barrier to vertical migration of water into or out of the Surficial Aquifer System.

Tamiami Formation. The Tamiami Formation consists of a number of different lithologies. Low permeability, poorly hardened limestones, dolosilts, and calcareous sands characterize the top of the Tamiami. Below this semi-confining unit is a sandy, fossiliferous limestone which is the primary water producer of the Lower Tamiami Aquifer. This limestone grades downward into the coarse Miocene clastics of the Upper Hawthorn Group (Knapp et al., 1986).

The three limestone formations that comprise the surficial sequence of the Everglades Basin were deposited in shallow Pleistocene seas. These formations are the Fort Thompson, the Anastasia, and the Miami Oolite.

The Fort Thompson Formation underlies the northern half of the basin, extending south into Miami-Dade County. It is characterized by marine and freshwater marls, limestone and sandstone at a depth of approximately 165 feet (50.3 m) (Parker and Hoy, 1943; Hoffmeister, 1974).

The Anastasia Formation is the main surficial sequence beneath the southern Everglades. It varies in composition from calcareous sandstone to biogenic limestone and coquina rock. Where exposed in the west, the Anastasia Formation is marked by facies containing bryozoan fossil assemblages. This bryozoan facies dips to the east, where it is covered by oolitic rock, a variety of limestone composed of minute spherical grains of calcium carbonate (Hoffmeister, 1974).

The Miami Oolite Formation extends from north of Miami southwestward to Homestead and westward into the ENP. Maximum elevation for this formation occurs at 23 feet (7 m) above mean sea level (Hoffmeister et al., 1967) in the Coconut Grove area. From there the formation dips to the west, where it disappears under the wetlands of the Everglades. The oolitic rock of the Miami is soft and friable in nature, except where it has been hardened by exposure to the atmosphere. The surface of the formation is honeycombed with holes and fissures. These features, the result of chemical weathering, facilitate the rapid infiltration of rainfall to groundwater (Hoffmeister, 1974).

3.7.3 Soils

The primary soils of the study area are organic sediments (see Figure 2, Lakebelt Study Area Soil Types Map). Table 3.7.3-1 lists the acreage for each of the 13 soil types that occur within the Lakebelt area. The study area is dominated by Lauderhill Muck, Depressional (27,600 acres, 57% of the study area). Pahokee Muck covers the second largest area (6,522 acres) and coincides well with the vegetation cover type Prairie. Dania Muck (6,160 acres) dominates the northern part of the study area. Smaller patches throughout the Lakebelt region represent other soil types. Note that acreage for Demroy Muck is reported in Table 3.7.3-1, but does not appear on the map legend because it was not visible at the mapped scale.

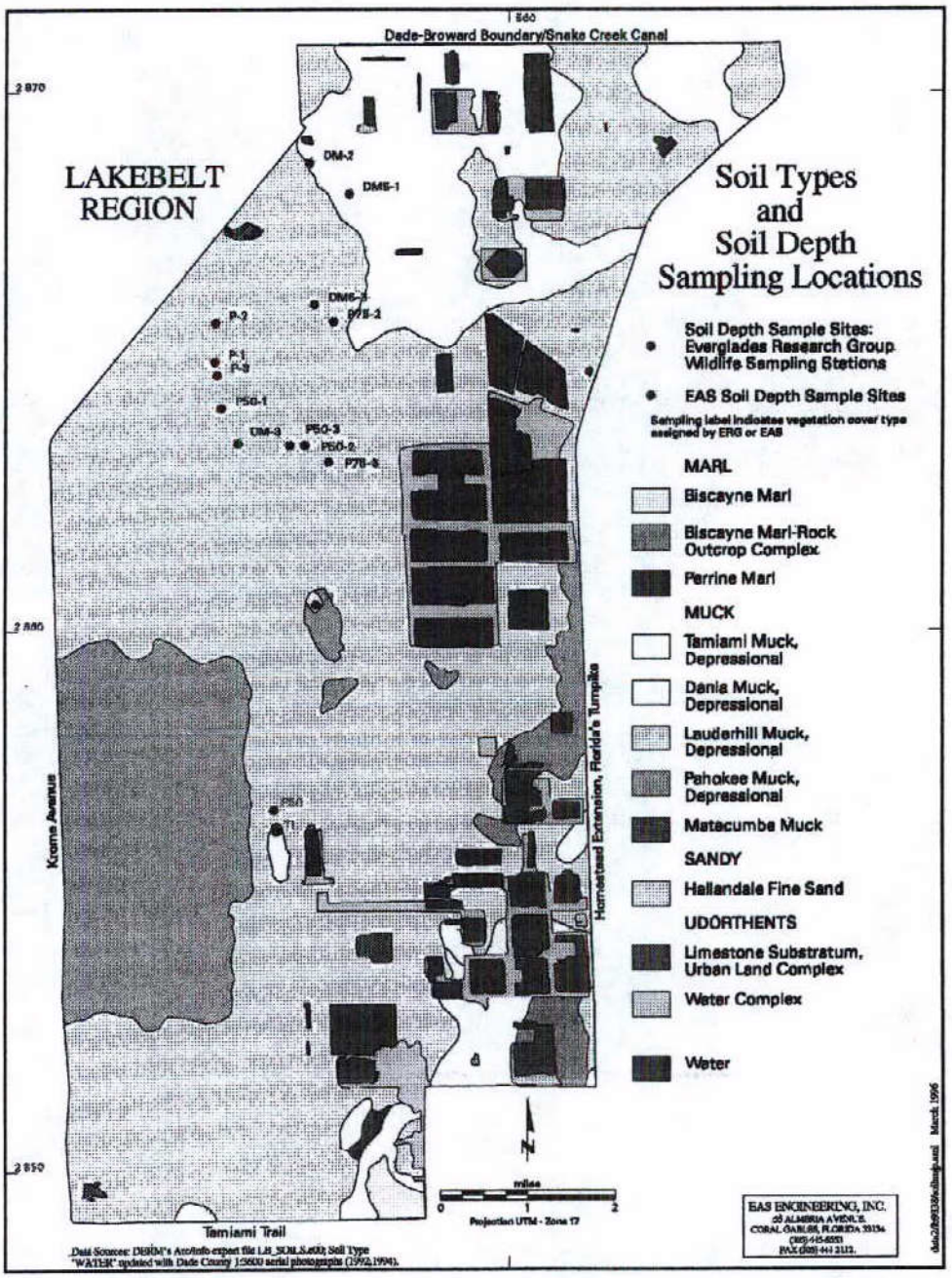

Figure 2 Soils Map

Table 3.7.3-1 Acreages of Soil Types

Soil Types	Acreage
Biscayne Marl	186.0
Biscayne Marl-Rock Outcrop Complex	300.0
Dania Muck, Depressional	6,160.0
Demroy Muck Sandy Clay Loam-Rock Outcrop Complex	0.04*
Hallandale Fine Sand	64.0
Lauderhill Muck, Depressional	27,600.0
Metecumbe Muck	9.0
Panokee Muck, Depressional	6,522.0
Perrine Marl	65.0
Tamiami Muck, Depressional	116.0
Udorthents, Limestone Substratum Urban Land Complex	126.0
Udorthents-Water Complex	2,181.0
Water	4,567.0

* The area covered by this soil type is too small to appear on the map.

3.8 Hydrology

The following section provides a summary of the regional modeling studies conducted by the staff of the South Florida Water Management District. The studies were conducted to evaluate the question of what is the current rate of seepage out of the Everglades Protection Area as a result of current anthropogenic activities and the impacts/benefits resulting from varying acreage of rock mining in the Lakebelt region, associated with the Northwest Miami-Dade County Freshwater Lake Plan. The modeling reports are contained in this PEIS as **Appendix A**.

Under current conditions ground water is moving from the Everglades Protection Area towards the east as a result of a higher water surface elevation in the Everglades Protection Area than on the east side of the levee, within the urban protection area, the cone of influence from public wellfield pumpage, and the high porosity of the limestone that underlies the region. These factors translate into a very high ground water seepage rate. The average annual rate of seepage from the Everglades area to the lower East Coast is approximately 190,000-acre feet. During wet years this rate increases to 290,000-acre feet (Figure 3). Because of this condition, areas within the Everglades Protection Area and the Pennsuco wetlands are experiencing declining water levels and hydroperiods (Figure 4).

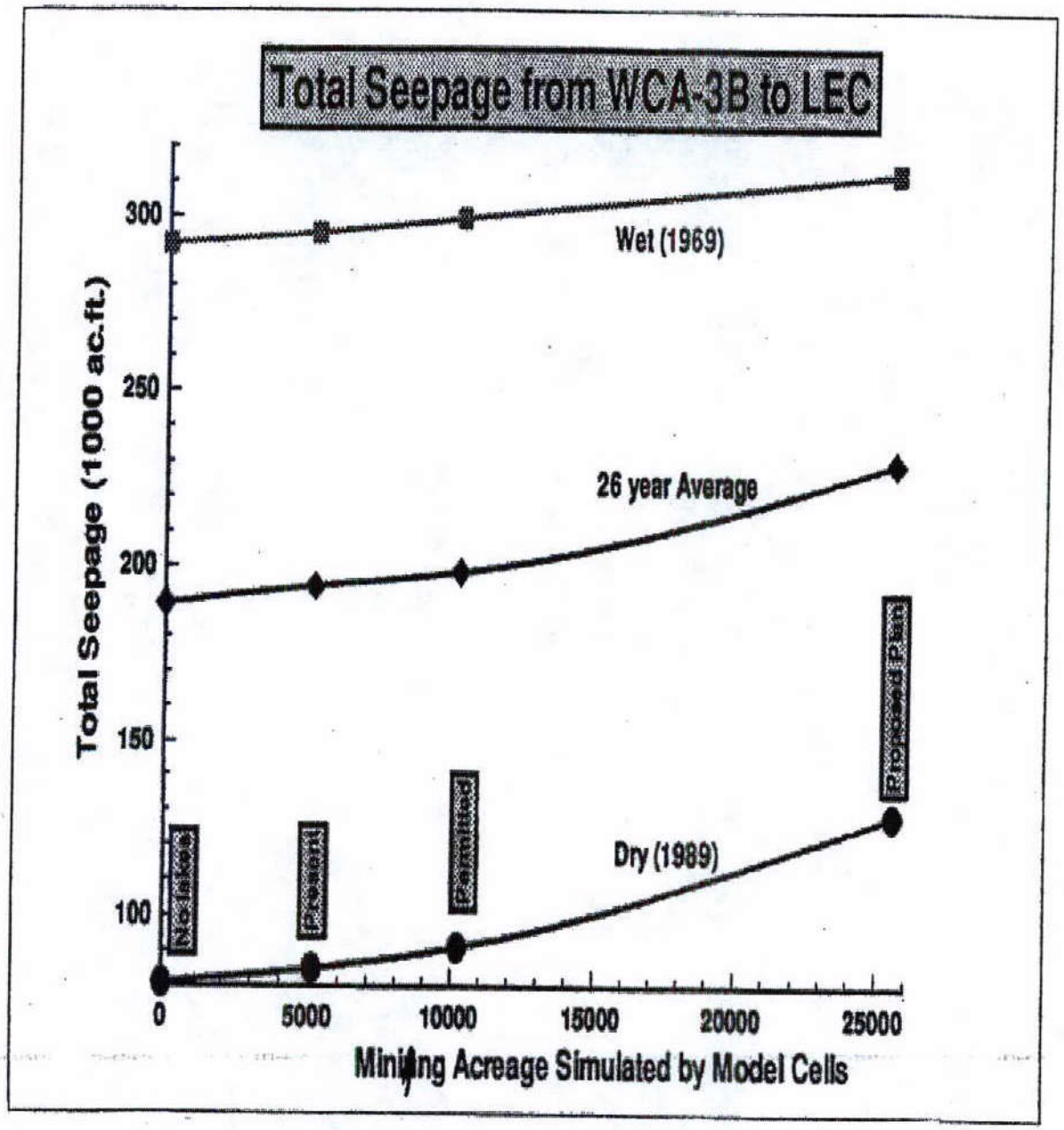

Figure 3 Average Annual Seepage lost to LEC Across N-S Levee in WCA-3B

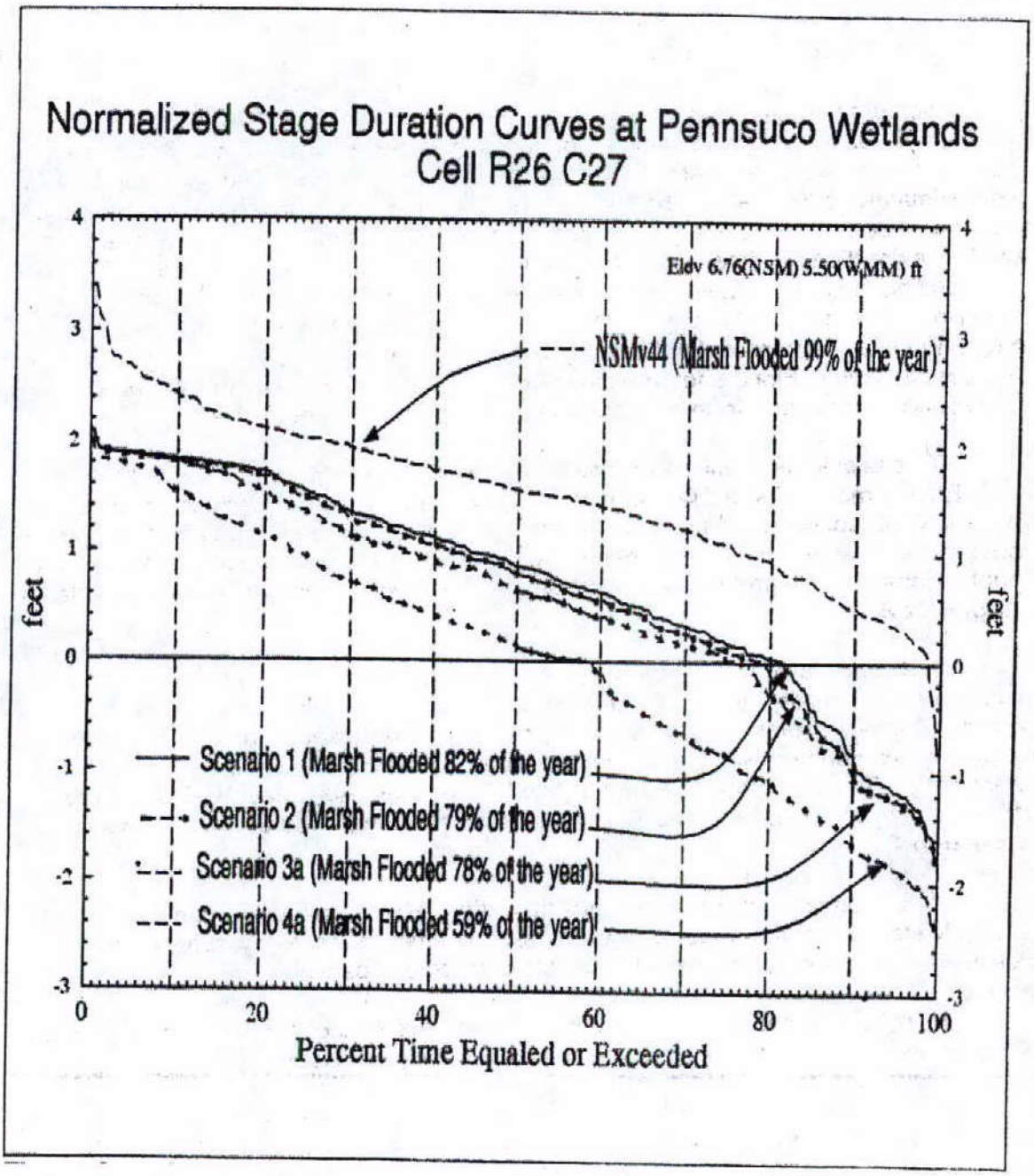

Figure 4 Normalized Stage Duration Curves in a model cell (R26 C27)

3.9 Water Quality

Water resources within the Lakebelt area consist of groundwater, natural wetlands, and two types of man-made surface waters: borrow pits and canals, which are depicted schematically in Figure 5. The Biscayne Aquifer is the primary source of drinking water for the Miami-Dade County area. The Biscayne Aquifer is a surficial aquifer, which starts beneath the overlying wetland soils and extends to a depth of approximately 100 feet. The aquifer is composed of varying limestone-bearing materials such as shells, coral, and sand. Borrow pits are the man-made lakes created by the extraction of limestone; the excavated cavity then fills with water from the surrounding aquifer. Originally, canals were constructed to convey stormwater from low-lying areas to coastal waters, thereby reducing frequent flooding in large areas of South Florida. More recently, SFWMD has used canals to redistribute water resources throughout South Florida for groundwater recharge and Everglades protection (i.e., conveying water to and from conservation areas and Lake Okeechobee).

To assist in evaluating water quality impacts of the proposed "Lakebelt Plan," the U.S. Environmental Protection Agency examined existing water quality information from a variety of sources, including local and state water quality monitoring programs, government reports and documents, resource assessment reports, and scientific publications. A comprehensive report on the review of this information is provided in **Appendix B**.

A water quality sampling program was designed and conducted to characterize existing water quality and to identify processes and conditions that affect the water quality of groundwater, borrow pits, and canals in the Lakebelt area. The sampling program included borrow pits (and sediment), groundwater, and canal sampling stations (Figure 6). Samples were collected at two time periods: April/May 1995 and February 1996. The methodology and results of this sampling program are contained in **Appendix B**.

In a comparison of water quality within mining lakes to canal and groundwater quality a number of water quality parameters were measured. The following discussion summarizes the results of these comparisons.

Many canal and groundwater station samples exceeded the 1 mg/L drinking water standard for iron. None of the borrow pit samples exceeded the iron standard. The drinking water standard for manganese was exceeded in some of the groundwater samples, but not in any canal or borrow pit samples. The iron and manganese standards exceeded are only secondary taste and odor standards. Lead was the only other drinking water standard exceeded in some groundwater samples. However, these exceedances are probably attributed to the well casings.

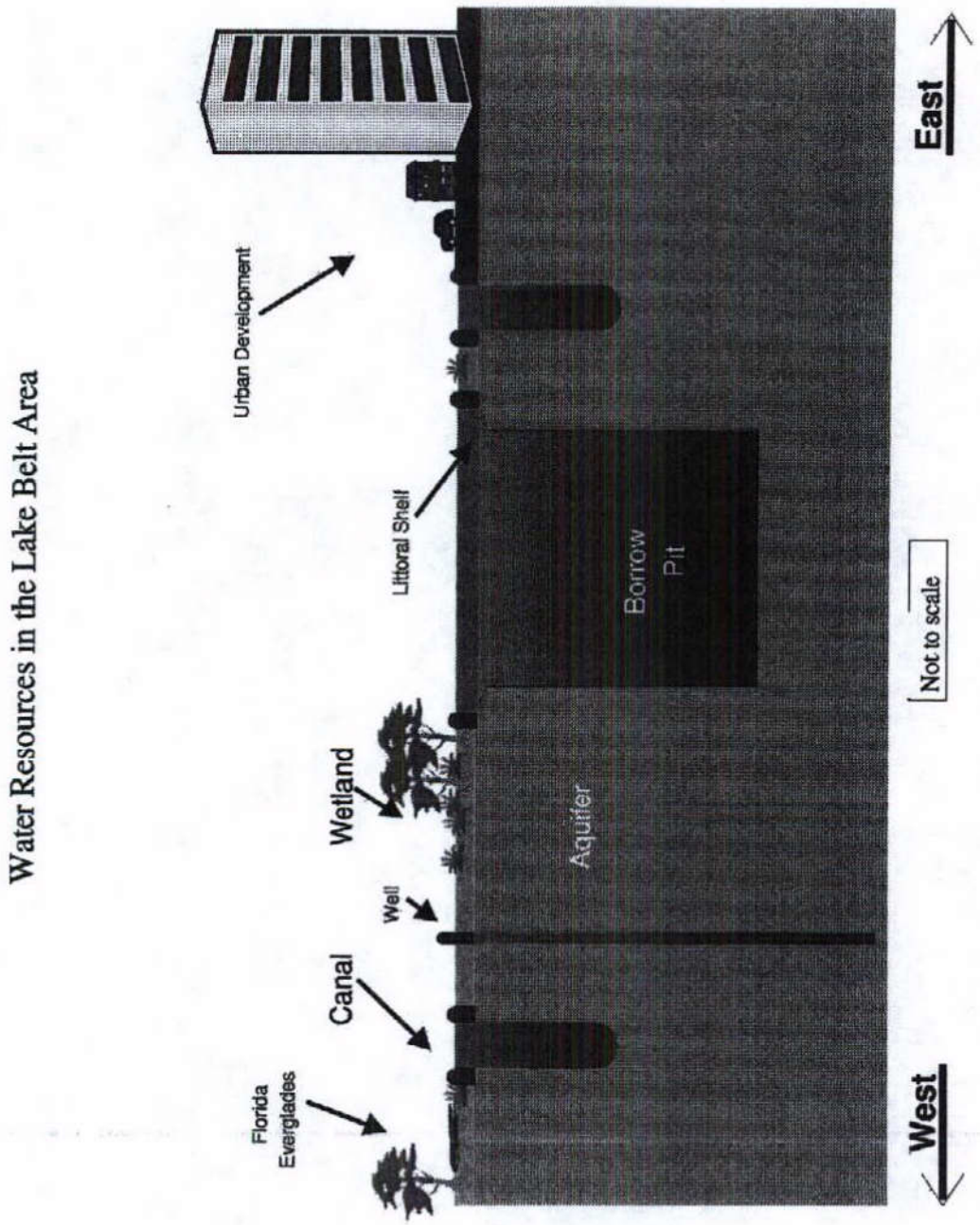

Figure 5 Water Resources Schematic

The ammonia nitrogen concentrations in canal water and groundwater approached the aquatic un-ionized ammonia water quality standard. In contrast, borrow pit ammonia concentrations were measured at or less than detection limits, well below the aquatic water quality standard.

Results of zinc testing suggest that bio-geochemical processes in borrow pits may be removing any zinc present in influent groundwater. Zinc was detected in many groundwater wells and in several borrow pit samples, but not in any canal samples. Two groundwater stations measured zinc concentrations at levels greater than the 0.5 mg/L aquatic water quality standard for surface waters. The two borrow pits proximate to these wells did not yield detectable levels of zinc.

Phosphorus, an important nutrient in surface waters, was detected in one half of the groundwater samples, but only at concentrations near the detection limit of 0.02 mg/L. In contrast, phosphorus was detected in only two borrow pit samples and in none of the canal samples.

Alkalinity, calcium, magnesium, and potassium levels in borrow pit samples measured lower than canals and groundwater. The lower borrow pit alkalinities are attributed primarily to the lower concentrations of base cations such as calcium and magnesium. These lower base cation concentrations may be due, in part, to carbonate precipitation in the borrow pits.

Total organic carbon was lower in borrow pit samples than in canal and groundwater samples. Paired comparison of borrow pits and proximate canals found total organic carbon as much as 10 mg/L lower in borrow pits than corresponding canal stations. Similarly, paired comparison of borrow pits and groundwater found total organic carbon more than 10 mg/L lower in borrow pits than in proximate groundwater stations. The lower borrow pit levels may be a result of chemical and bacterial oxidation of the organic substances in the water and/or a result of absorption of carbonate and oxide precipitates.

Nitrates measured considerably higher in borrow pits than in canals and groundwater. These higher nitrate levels along with the absence of ammonia, suggest that nitrification of ammonia is occurring in the borrow pits.

PH levels of borrow pit samples were higher than groundwater and canal samples. The higher pH measurements probably result from aeration of the large open water areas of the borrow pits, which would remove carbon dioxide, thereby increasing pH.

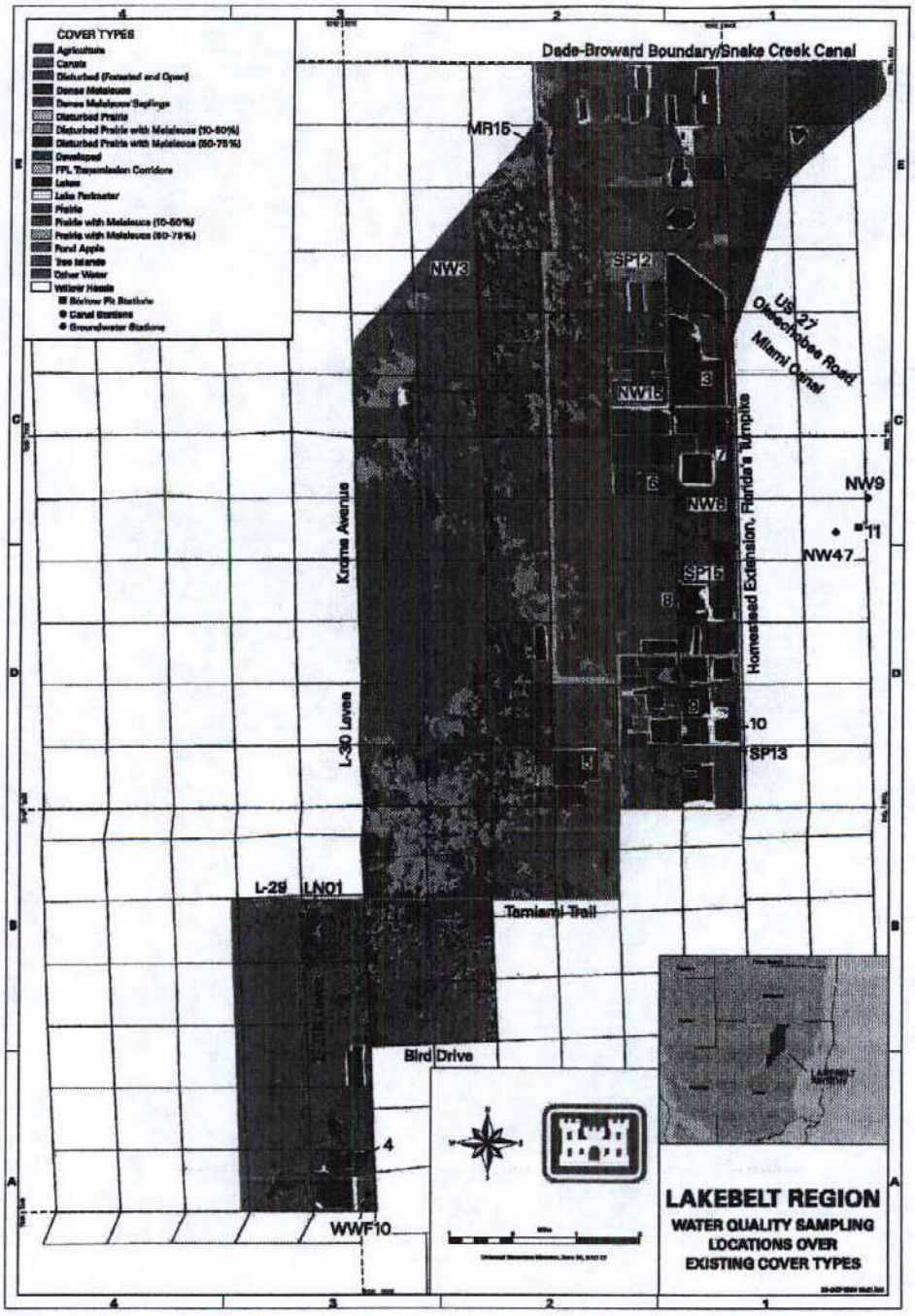

Figure 6 Water Quality Sampling Location Map

3.10 Vegetation

The boundaries of the study area with the covertype mapping are shown in Figure 7. Approximately 57,515 acres of land are present within the study area, comprising both natural, disturbed, and developed areas. The covertype mapping of the Lakebelt study area north of Tamiami Trail (US 41) was performed in 1994 by EAS Engineering of Coral Gables, Florida under contract to Miami-Dade County, Department of Environmental Resources Management (DERM), which is a cooperating agency with the USACOE for the Lakebelt study. The area south of Tamiami Trail was mapped by EAS Engineering, Inc. in 1997 under contract to the USACOE. EAS Engineering, Inc. conducted an inventory of the northern Lakebelt study area, to include: 1) mapping the study area's vegetation, soils, and topography, 2) analyze the existing and historical distribution of the Australian tree, *Melaleuca quinquenervia*, and 3) analysis of the collected data for a correlation between Melaleuca distribution and soil type, topography, or hydrology. Historical analyses of *Melaleuca* infestation in both the entire Lakebelt region and eight sections of the study area were conducted by comparing digitized maps of aerial photographs from 1963 to 1992. Analyses of correlations between *Melaleuca* cover and soils, topography, and hydrology were performed.

Approximately 30% of the Lakebelt Region has been altered by man. Most of this activity, dominated by rock mining and agriculture, has occurred north of Okeechobee Road and along the eastern side of the study area. Natural cover types, the remaining 70% of the study area, are found primarily in the Pennsuco Wetlands and in the western areas along the Dade-Broward Levee. Prairie with varying degrees of *Melaleuca* infestation was the prevalent natural community type. Tree Islands and Willow Heads, the only indigenous wetland forested vegetation community types found, occupied less than 1% of the study area. The results of this study are contained in this report as **Appendix C**.

The covertypes are divided into two basic groups, natural covertypes and man-altered covertypes. Table 3.10-1 lists these covertypes and their acreages within the Lakebelt Study Area.

In general, the man-altered covertypes tend to occur north of Okeechobee Road (Highway 27) and along the eastern side of the study area, while the natural covertypes occur within the Pennsuco Wetlands, portions of the western areas along the Dade-Broward Levee and the Bird Drive Basin.

3.10.1 Natural Covertypes

The natural covertypes are comprised of a series of jurisdictional (Florida Department of Environmental Protection, South Florida Water Management District, Miami-Dade County Department of Environmental Resources Management, and U.S. Army Corps of Engineers) wetland prairie associations impacted by varying percent

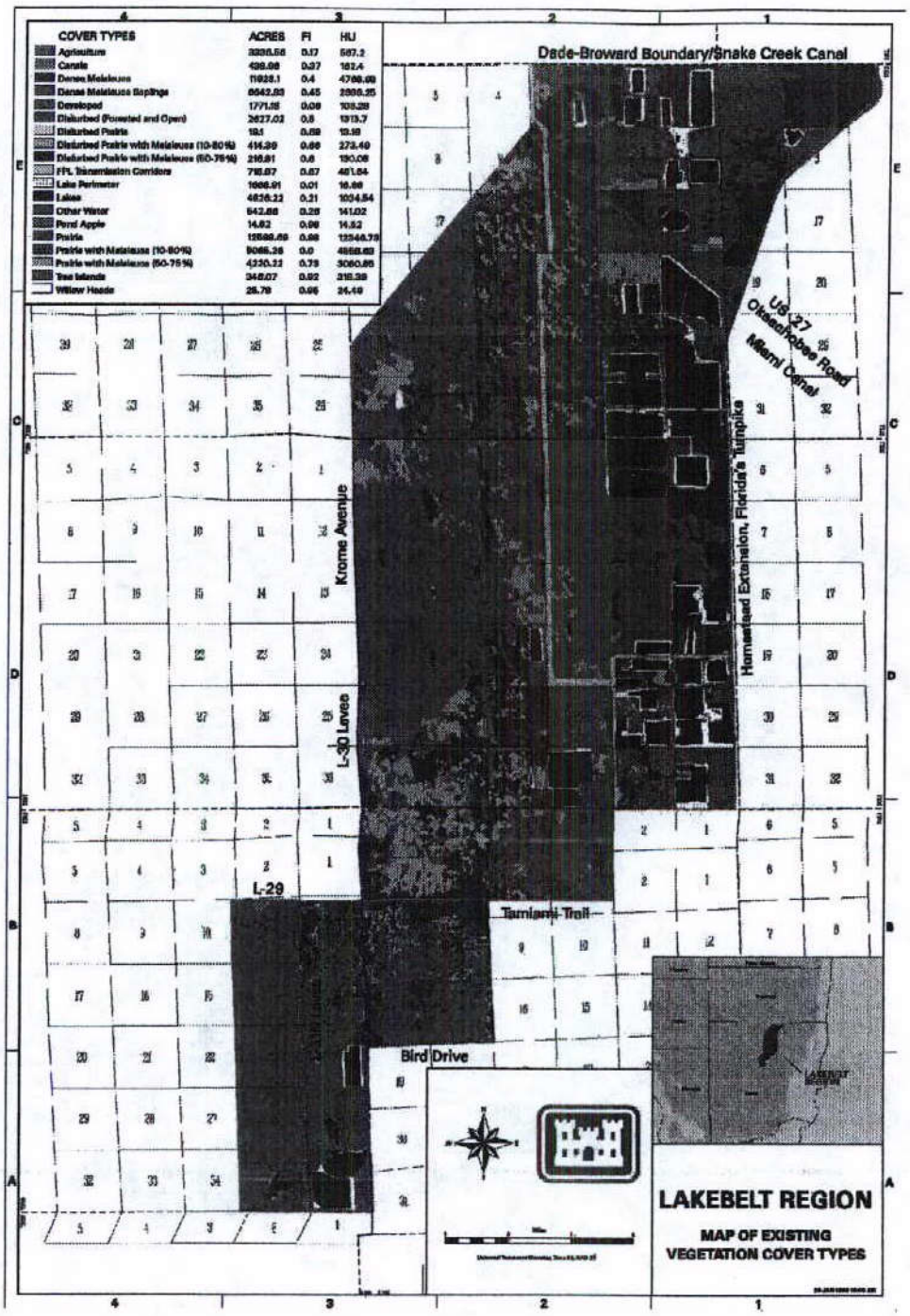

Figure 7 Existing Vegetation Coverage Map

coverage of Melaleuca. (Two categories, Dense Melaleuca (DM) and Dense Melaleuca Saplings (DMS) are former wet prairie associations that are 75% to 100% covered in Melaleuca forest.) Also included in the natural covertypes are the forested willow head and tree island communities. The following is a description of the natural covertypes found within the study area.

Table 3.10-1 Acreages Of The 19 Lakebelt Study Area Covertypes

Natural Covertypes	**Acres**
Prairie	12,598.69
Prairie with Melaleuca (10-50%)	5,065.26
Prairie with Melaleuca (50-75%)	4,220.22
Dense Melaleuca	11,923.10
Dense Melaleuca Saplings	6,642.83
Tree Islands	346.07
Willow Heads	25.78
Pond Apple	14.82
Man-Altered Covertypes	
Disturbed (Forested and Open)	2,627.02
Disturbed Prairie	19.10
Disturbed Prairie with Melaleuca (10-50%)	414.39
Disturbed Prairie with Melaleuca (50-75%)	216.81
Canals	438.96
Lakes	4,926.22
Lake Perimeter	1,666.91
Other Water	542.66
Agriculture	3,336.56
FPL Transmission Corridors	718.87
Developed	1,771.18
Total	**57,515.45**

Prairie (P): The prevalent community type within the Lakebelt Study Area is the short hydroperiod (three to six months) and longer hydroperiod (six to nine months) wet prairie communities dominated by graminoids and other herbaceous species, occurring on muck-dominated soils (Richter et al., 1990). In the Pennsuco wetlands west of the Dade-Broward Levee, the hydroperiod ranges from six to nine months. Within the majority of the Lakebelt study area, the graminoid Sawgrass (*Cladium jamaicense*) is the dominant indigenous species of this prairie community, with patchy areas, especially in the southern areas of the Lakebelt Study area containing a significant component of one or more of the following graminoid species, Beardgrass (*Andropogon glomeratus*), Broomsedge (*Andropogon virginicus*), Sheathed Cyperus (*Cyperus haspan*), Erect Panicum (*Dichanthelium erectifolium*), White Top (*Dichromena colorata*), Spikerush (*Eleocharis* spp.), Elliott's Lovegrass (*Eragrostis elliottii*), Sugarcane Plumegrass (*Erianthus giganteus*), Muhly (*Muhlenbergia capillaris*), Red Top Panicum (*Panicum rigidulum*), Bluejoint Panicum (*Panicum tenerum*), Spreading Beakrush (*Rhynchospora divergens*),

Littleseed Beakrush (*Rhynchospora microcarpa*), Tracy's Horned Rush (*Rhynchospora tracyi*), and Narrow Beardgrass (*Schizachyrium rhizomatum*). Common herbaceous components of this community include Coinwort (*Centella asiatica*), String Lily (*Crinum americanum*), Oak-leaved Fleabane (*Erigeron quercifolius*), Fennel (*Eupatorium leptophyllum*), Yellowtop (*Flaveria linearis*), Marshelder (*Iva microcephala*), Creeping Charlie (*Phyla nodiflora*), Marsh Fleabane (*Pluchea rosea*), Swamp Mermaid (*Proserpinaca palustris*), and Water Pimpernel (*Samolus ebracteatus*). Numerous other herbaceous and graminoid species are present in this community. There is substantial patchiness of plant species types within this prairie community, attributable to differences in soil type and depth, surface water depth, and perturbation factors.

Within the prairie community, indigenous tree and shrub species occur sporadically. The most prominent species include Buttonbush (*Cephalanthus occidentalis*), St. Andrew's Cross (*Hypericum fasciculatum*), Dahoon Holly (*Ilex cassine*), Wax Myrtle (*Myrica cerifera*), and Swamp Bay (*Persea palustris*). Coverage of Melaleuca in this habitat type is less than 10%.

Also within the prairie community, and most prominently in the prairies of the Pennsuco Wetlands, is a subcommunity type called "flats" which is quite different both floristically and structurally from the surrounding prairie. Flats tend to be very small in size and dominated by herbaceous and graminoid species, but do not include Sawgrass. The vegetation is typically substantially shorter and usually less dense than in the surrounding prairie. Periphyton usually attains its greatest development in the flats subcommunity type. Netted Shy-leaf (*Aeschynomene praetensis*), String Lily, Spikerush (*Eleocharis cellulosa*) and Tracy's Horned Rush (*Rhynchospora tracyi*) are among the most common species in these areas.

The largest contiguous area of prairie vegetation is located in the central Pennsuco wetlands. Other much smaller areas are present east of the Dade-Broward levee primarily in the southern reaches of the Lakebelt Study area. A total of 12,598.69 acres of prairie habitat are present within the Lakebelt Study area.

Prairie with Melaleuca: As discussed above, Melaleuca has invaded the prairie wetlands in southern Florida, and occurs in varying amounts throughout the study area. For purposes of mapping and correlating associated wildlife usage, two categories of prairie with Melaleuca have been delineated. These are prairie with Melaleuca coverage at between 10% and 50%, and prairie with Melaleuca between 50 and 75% coverage.

Prairie with Melaleuca, 10% - 50% (P50) retains its primary vegetative character as prairie, with only minor reduction in species richness and dominance of graminoid and herbaceous vegetation. The habitat is characterized by relatively open areas with usually small clumps of Melaleuca scattered randomly throughout the area. A total of 5,065.26 acres of this habitat are present within the study area. The largest concentration of these habitats is in the north central Pennsuco wetlands and east of the Dade-Broward levee in the same general area.

Prairie with Melaleuca, 50% - 75% (P75) retains some character as prairie, with moderate reduction in species richness and dominance of graminoid and herbaceous vegetation. Medium density tree cover characterizes the habitat with some, more relatively open areas interspersed randomly throughout the area. A total of 4,220.22 acres of this habitat are present within the study area. The largest concentration of this habitat is in the southern portions of the Pennsuco wetlands and east of the Dade-Broward levee in the north central portion of the study area south of Okeechobee Road.

Melaleuca Forest: Within the study area, Melaleuca has attained forest stature or density in many places. Two categories of so-called dense Melaleuca have been mapped for this study.

Dense Melaleuca (DM) is best described as closed canopy stands of Melaleuca that can attain heights of 30 to 40 feet. Within these stands, the density of trees can vary from relatively open to very dense Melaleuca thickets. By definition, these areas attain 100% coverage of Melaleuca. The understory is very sparse, and contains a few of the prairie species, most of which exhibit etiolation and other signs of diminished light levels. Certain other species are present in the understory, the most common being Royal Fern (*Osmunda regalis*), Swamp Fern (*Blechnum serrulatum*) and Shield Ferns (Thelypteris spp.). Occasional Wax Myrtles, Red Bays, and Dahoon Hollies are found, as well as *Baccharis* spp. A total of 11,923.10 acres of the study area is covered in Dense Melaleuca forest. Dense Melaleuca predominates in the southern portion of the Pennsuco Wetlands, and in large areas both north and south east of the Dade-Broward Levee.

Dense Melaleuca Saplings (DMS) can be described as Melaleuca forest that has attained a height of about 15 feet or less. It is characterized by having an extremely high stem density, and consequently, there is little opportunity for other species to occur in this habitat. Most of this habitat is the result of Melaleuca areas recovering from the hot wildfires of 1990. Approximately 6,642.83 acres of this habitat occurs within the Lakebelt Study Area, most of it located in the central portion of the study area and east of the Dade-Broward levee, centered around the pumps for the Northwest Wellfield.

Tree Islands and Willow Heads: The only indigenous, wetland forested vegetation community types found in the study area are tree islands and willow heads.

Tree Islands (TI) are dominated by the trees Red Bay (*Persea borbonia*), Coastal Plain Willow (*Salix caroliniana*), Brazilian Pepper (*Schinus terebinthifolius*), and West Indies Trema (*Trema micrantha*), and the shrubs Groundsel Tree (*Baccharis glomeruliflora*), Shrubby Waterprimrose (*Ludwigia octovalvis*) and Wax Myrtle (*Myrica cerifera*). Numerous other species of trees, shrubs and ground covers are also present in the tree island habitat. A total of 346.07 acres of tree island habitat have been identified in the study area. All of these areas have been impacted by wildfires and have shrunk considerably in size from historical levels. Many areas of former tree islands are now covered in Dense Melaleuca habitat.

Willow Heads (WH) are dominated by Coastal Plain Willow, and contain other shrubs and numerous herbaceous species. A total of 25.78 acres of Willow Heads occurs in the Study Area.

Pond Apple Slough (PA) is a small 14.82 acre area in the northern part of Section 11, Township 54 South, Range 38 East, abutting Tamiami trail and influenced by water released from WCA-3B to the north. Pond Apple trees (*Annona glabra*) that are 25 to 30 feet tall overwhelmingly dominate the community. Very large Leather Fern (*Acrostichum danaeifolium*) dominates the understory. In some of the more open areas, sawgrass is present in the understory. In the deepest part of the slough, Spatterdock (*Nuphar luteum* ssp. *Avena*) is present. This particular habitat is found nowhere else within the Lakebelt study area.

3.10.2 Man-Altered Covertypes

The man-altered covertypes include a series of water bodies, including canals, lakes, and other water areas such as impoundments, temporary ponding, etc. A series of modified habitats are also included in this group of covertypes, including agriculture, lake perimeter (which are scarified areas surrounding lakes), and developed areas. Other disturbed areas include disturbed prairie, disturbed prairie with 10%-50% Melaleuca, and disturbed prairie with 50%-75% Melaleuca as well as vegetated disturbed areas, some of which are not wetland jurisdictional. The final disturbed covertype is the Florida Power & Light high voltage transmission lines that occur within the study area. These areas primarily consist of a filled access road, surrounded by prairie-wetlands that are periodically mowed to retard tree growth. The following is a description of the Man-altered covertypes found within the Lakebelt study area:

Disturbed Areas (D): Disturbed areas within the Lakebelt Study Area consist of forested disturbed areas, open disturbed areas, and several prairie and prairie with Melaleuca covertypes.

Forested disturbed areas are primarily upland and occur on canal berms, along roadsides in areas of old fields that have been allowed to return to forest-type habitat, and on rock mine spoil areas that have been allowed to revegetate. The five most common tree species in these habitats are Australian Pine (*Casuarina equisetifolia*), Beefwood (*Casuarina glauca*), Cajeput (*Melaleuca quinquenervia*), Brazilian Pepper (*Schinus terebinthifolius*), which are exotic, noxious species, and the indigenous West Indies Trema (*Trema micrantha*). A large number of other trees, shrubs, and herbs, including numerous ornamental exotics, which have colonized from dump piles, occur in the community type.

Open disturbed areas consist of disturbed areas without a forest canopy, and are comprised primarily of roadsides, old fields, and lake perimeter areas. Most of these areas are uplands, but some areas are wet old fields. No one species or group of species is dominant in this community type, but herbaceous weedy species and woody nuisance

species are the most common. Disturbed Areas comprise 2,627.02 acres of the study area, and are located primarily in the north and eastern portions of the site.

Three small, disturbed covertypes occur as a result of removal of most of the Melaleuca, periodic mowing, and maintenance of the sites in this condition. These are Disturbed Prairie (DP), 19.10 acres, Disturbed Prairie with 10% to 50% Melaleuca (DP50), 414.39 acres, and Disturbed Prairie with 50% to 75% Melaleuca (DP75), 216.81 acres.

Canals (C): This covertype consists of canals, ditches, and other excavated water bodies that contain at least some open water all year round. Primary species located in these areas include Spatterdock (*Nuphar luteum*) and Cattails (*Typha dominigensis*). A total of 438.96 acres of canals are present within the study area.

Lakes (L): Borrow areas from rockmining are primarily large square lakes, up to sixty feet in depth, which occur in the eastern half of the study area. Most of the water bodies do not contain any vascular plant species. Lakes comprise 4,926.22 acres of the study area.

Lake Perimeter (LP): The work areas around each rock mine consist primarily of scarified non-vegetated areas that comprise this covertype. 1,666.91 acres of lake perimeter covertype occurs within the Lakebelt study area.

Other Water (W): This covertype is comprised of shallow impoundments and temporary ponds that are primarily associated with on-going rockmining and occur in and around lake perimeters. These water bodies are often vegetated with a variety of annual and short-lived wetland species that tolerate extremes of fluctuating water levels. Typical species associated with these areas are Matted Figwort (*Bacopa monnieri*), Tropical Flatsedge (*Cyperus surinamensis*), Purple Spikerush (*Eleocharis atropurpurea*), Hurricane Grass (*Fimbristylis spathacea*), Umbrella Sedge (*Fuirena breviseta*), Marsh Pennywort (*Hydrocotyle umbellata*), Many-headed Rush (*Juncus megacephalus*), Shrubby Water Primrose (*Ludwigia octovalvis*), Fall Panicum (*Panicum dichotomiflorum*) and Marsh Fleabane (*Pluchea odorata*). This covertype occupies 542.66 acres of the study area.

Agriculture (AG): This covertype is composed of pasture areas, improved pasture areas, tree farms and nurseries, sugar cane fields and other crops. A total of 3,336.56 acres of the study area are in agriculture. Agricultural areas support a large number of weedy plant species, both wetland and upland. Agricultural areas are concentrated in the area north of Okeechobee Road, and in the southeastern portion of the study area.

FP&L Transmission Corridors (FPL): This covertype was generated because these area are kept maintained by removal of Melaleuca and other tree material, but otherwise are left as functioning wetland areas. A total of 718.87 acres of the study area are included in the transmission corridor covertype.

Developed (DV): The remainder of the study area (1,771.18 acres) is composed of developed areas, including roads, buildings, parking lots, etc. These areas contain numerous exotic landscape plants, and areas of nuisance and exotic vegetation along fence lines and non-maintained areas.

Appendix C presents a complete list of the vascular plant species observed in the Lakebelt Study Area. Additional information contained in **Appendix C** includes the relative abundance of each plant species, its status on federal, state and local wetland plant lists, its status on state and federal rare and endangered plant species lists and its habitat affiliations within the study area.

3.10.3 Endangered and Threatened Plant Species

Appendix C also indicates which plant species found within the study area are categorized as rare or endangered by the federal, state and Miami-Dade County governments. No federally listed plant species were observed within the Lakebelt Study Area.

The State of Florida classifies fifteen plant species within the study area as Threatened. Nine of these species are ferns that are relatively widespread and common within southern Florida. Six of the species are terrestrial orchids, which are still relatively common and widespread in southern Florida.

The State of Florida categorizes two species as Commercially Exploited. Both species are relatively common in the Lakebelt Study Area.

Five species of plants are categorized as Rare by Miami-Dade County, while four species are classified as Uncommon to Common. The five rare species are some of the same ones classified by the state of Florida. Two of the Uncommon to Common species are endemic species occurring in freshwater wetland areas in southern Florida.

No plant species that are truly endangered or threatened occur within the Lakebelt Study Area.

3.10.4 Factors Influencing Covertypes

Abiotic factors that have influenced the current composition of the covertypes in the Lakebelt Study Area include, (1) generalized historical alteration (lowering) of the water table with associated canal and drainage ditch excavations and berming; (2) rockmining throughout the eastern portion of the study area; (3) development and urbanization, including road building; (4) construction of high voltage electrical power transmission corridors; (5) construction and operation of a public wellfield; and (6) periodic uncontrolled wildfires that have historically ravaged the study area.

The primary effects of these abiotic factors on the vegetation covertypes within the study area have been to shorten hydroperiods and to disrupt and redirect surface water sheet flows from historical conditions. These modifications have resulted in the alteration of the historical long hydroperiod wetlands to shorter hydroperiod prairies, causing shifts in vegetative species composition and species richness. The rockmining industry has created extensive areas of deep-water habitat (to depths of 60 feet), which do not naturally occur in southern Florida.

Secondary effects of these abiotic factors have been to create extensive areas of disturbed land which have been colonized by weedy and/or noxious exotic vegetation, as discussed above. Another effect of the ongoing rockmining is the creation of temporary water bodies, which are colonized by numerous wetland species.

Wildfires are a normal part of the cycle of the natural habitats within the study area. However, the alteration of hydroperiods and water levels, coupled with the extensive invasion of the area by Melaleuca, and drought conditions which occurred in the late 1970s and late 1980s resulted in extremely hot wildfires in portions of the study area. Many areas had the organic substrate burned out to the rock layer. These effects were particularly severe in the vicinity of the Northwest Wellfield. Furthermore, many of the tree island habitats have been severely impacted by wildfires, resulting in invasion by exotic species and shrinking of the areas covered by tree islands.

The principal biotic factor that affects the covertypes in the study area is the colonization of prairie wetland habitats by the noxious exotic tree Melaleuca (*Melaleuca quinquenervia*). Melaleuca, comprising from 10 to 100% of the vegetation coverage, affects more than 29,000 acres of the study area. Consequently, only 12,598 acres of prairie wetlands within the study area have less than 10% Melaleuca coverage presently.

Noxious exotic plants and weedy species also dominate most of the areas within the study area classified as disturbed, lake perimeter, agriculture, and developed lands.

3.10.5 Melaleuca Expansion

Since its introduction into South Florida in 1906, Melaleuca has become established in areas that were historically wetlands, especially those stressed by reduced hydroperiods. This species negatively impacts wetland function, thus threatening the core of the Everglades ecosystem. Melaleuca drastically changes ecosystem structure and dynamics. Forests replace gramineous marsh, thus changing animal use. Leaf litter and woody debris change relative soil elevation and hence hydrology. Tree weight can compress underlying peat deposits. Melaleuca forests produce larger amounts of organic matter resulting in heavy fuel loads of very combustible materials, leading to very hot fires. Higher leaf areas increase evapotranspiration and lowers water tables; and leaf litter may produce allelopathic substances which, combined with dense evergreen shade, may eliminate understory species. For all this, Melaleuca has been declared a Federal Noxious Weed and a

Florida Prohibited Aquatic Plant. These regulations prohibit its importation into the United States and its transportation throughout Florida, respectively (Bodle et al 1994). The spread of Melaleuca has been described as explosive with an accelerating rate of spread (Hofstetter 1991, Cost & Craver 1980, Laroche & Ferriter 1992). An analysis and discussion of the distribution and expansion of Melaleuca is contained in **Appendix C**.

Melaleuca has expanded exponentially from 1963 to 1992, at which time it occupied nearly 45% of the Lakebelt Region. Most of this expansion occurred at the expense of prairie with melaleuca 10-50%, given that: a) prairie with melaleuca 10-50% decreased by 32,000 acres during the same period that dense Melaleuca increased by 21,000 acres, b) Tree Island, the only other cover type that decreased in size during the same period, was a very small component of the study area in terms of acreage (762 acres in 1963), and c) all other cover types increased due to human activity (Lakes and Disturbed) or remained unchanged (Canal). This is to be expected, since ML50 is only a transitional phase in the succession from prairie to dense Melaleuca. Once Melaleuca foci appear in prairie habitat, expansion is very rapid. The time that is required for Melaleuca to completely overcome a square mile section once the first foci appear is approximately twenty years. Our results agree with Laroche & Ferriter's (1992) conclusion that it takes 25 years to go from 2-5% Melaleuca cover to 95% Melaleuca cover.

Dense stands of Melaleuca presently occupy 44% of the Lakebelt Region. In portions of the Lakebelt Region, Melaleuca is apparently spreading rapidly in a westerly direction. No correlations were found between Melaleuca growth rate and topography, soil type or hydroperiod. Our data show that there may be an affinity for shallow soils, but a cause-effect relationship cannot be drawn from these limited data. Wildfires slow down its progress for a short time, but Melaleuca returns within a few years as dense stands of saplings, which will inevitably become dense Melaleuca forest.

3.11 Wildlife

The wildlife resources of the Lakebelt study area was evaluated by Everglades Research Group, Inc. under a contract with DERM. The evaluation period for the study was from January 1, 1994 through December 31, 1995. The results of the study, site selection, sampling methods, and statistical methods used in the study are presented in Everglades Research Group's final report to DERM dated May 1996, and contained in this report as **Appendix D**. The following information on wildlife resources of the Lakebelt study area is from this report. Literature cited in this section and its subsections (Existing Wildlife Resources) can be found in **Appendix D**.

The Lakebelt study area of northwestern Miami-Dade County covers 57,515.45 acres (EAS Engineering, Inc., 1995 & 1997). The region includes approximately 12,600 acres of sawgrass marshes with little to no invasion by the exotic pest plant *Melaleuca quinquenervia* (melaleuca). The area also includes approximately 10,000 acres of

moderate coverage by melaleuca (10% to 75% melaleuca) and 18,500 acres with greater than 75% coverage by melaleuca. The remainder of the area is composed of lakes, littoral zones, agricultural lands, canals, levees, correctional facilities, electrical power facilities, and power line right-of-way (EAS Engineering, Inc., 1995).

Previous studies on wildlife use of melaleuca have focused on either a few species (Mazzotti et al., 1981; Sowder and Woodall, 1985) or surveyed only dense melaleuca stands (Schortemeyer et al., 1981; Repenning, 1986). The objective of the Wildlife Studies portion of the Lakebelt Ecological Studies was a thorough evaluation of wildlife species diversity and habitat use of areas described as marsh, exotic plant invaded marsh, dense melaleuca, and other natural and man-made habitats. Wildlife was broadly defined to include selected macroinvertebrates (Crayfish, Grass shrimp), as well as fishes, amphibians, reptiles, birds, and mammals.

3.11.1 Habitat preference and species composition

Gross comparisons of the numbers of species or numbers of individuals found in each cover type did not yield significant differences among the cover types. However, multivariate analyses, which considered the contribution of each species to overall community composition, demonstrated differences between cover types. Indices of dispersion indicated that many faunal groups were distributed along a gradient other than melaleuca density. To assist in evaluating community composition in terms of hydrology, each species was categorized based upon their requirement for a particular, gross hydrologic pattern.

Macro-invertebrates and fishes were excluded from the wetland association analyses for two reasons. Firstly, most taxa in these groups are wetland dependent. Since large numbers of macro-invertebrates and fishes were trapped relative to all other faunal groups, their inclusion would swamp the analyses. Secondly, macro-invertebrates and fishes usually showed a positive correlation between the number of species and water levels. The objective of these analyses was to determine the relative quality of habitat based on the degree of melaleuca invasion, not water levels. Therefore, species groups that showed significant positive correlations with rising water level were more likely to confound the effects of melaleuca invasion and current hydrological patterns. In other words, it could be said that high numbers of species and, or individuals were related more to water levels than melaleuca density.

For the purpose of the analysis, species whose respiration, feeding mechanisms, reproduction or larval development require 9 to 12 months of standing water each year were termed "wetland dependent". Species whose respiration, feeding mechanisms, reproduction or larval development require 1 to 9 months of standing water each year were termed "seasonal wetland". Species whose respiration, feeding mechanism, reproduction or larval development is independent of standing water were termed "wetland independent". Animals described as "wetland dependent" or "seasonal wetland" use upland habitats, but a population could not persist without suitable wetland

habitat. Conversely, animals described as "wetland independent" use wetland habitats, but their life history traits allow them to survive and successfully breed outside of wetlands. The current assigned wetland association of each species of amphibian, reptile, bird and mammal is listed in **Appendix D**. Macro-invertebrates and fishes were excluded from the analyses.

When the 24 month cumulative data for all sampling methods were considered. The occurrence of "wetland dependent" and "seasonal wetland" species of amphibians, reptiles, birds, and mammals was highest in Marsh (0% to 10% melaleuca) and lowest in dense melaleuca saplings and dense melaleuca (75% to 100% melaleuca, either sapling or mature). In Marsh, wetland associated species accounted for 76% of the species and 91% of the individuals trapped or observed (Appendix D, Tab. 15). dense melaleuca saplings and dense melaleuca had the lowest percentage of wetland associated species (42% and 41%, respectively) and individuals (44% and 44%, respectively). Observed vs. expected numbers for wetland and non-wetland individuals and species per cover type both showed significant differences. There were fewer wetland and more non-wetland species occurring in the dense melaleuca saplings and dense melaleuca cover types (Appendix D, Figure 36).

The numbers of wetland dependent and seasonal (y-axis) versus numbers of non-wetland animals (x-axis) were plotted for each cover type (Appendix D, Figure 37). Regardless of whether the graphical analysis considered numbers of species or individuals of wetland versus non-wetland taxa, the patterns were the same. As succession moved from Marsh to Prairie with melaleuca (10-50%) and Prairie with melaleuca (50-75%), there was a curvilinear (negative exponential) trend for increased numbers of non-wetland species without a decrease in numbers of wetland species. Once melaleuca density went above Prairie with melaleuca (50-75%), wetland associated taxa decreased in both number and abundance. This indicated that the loss of wetland species habitat value did not occur until melaleuca density caused canopy closure (e.g. above 75% melaleuca coverage). The point at which the number of species or individuals of terrestrial taxa was equal to the number of wetland taxa was demarcated on the figures as straight lines from the origin of the graphs. This point was reached at or near Prairie with melaleuca (50-75%). The trend of increased species diversity was typical of intermediate stages in disturbed or degraded ecosystems (Odum, 1983).

It is important to recognize that species categorized as "wetland dependent" or "wetland seasonal" may require dry areas or have a preference for water depth. In fact, most wetland-associated vertebrate animals are adapted to using water depths of less than 25 cm (Fredrickson and Laubhan, 1994). Breeding densities of typical marsh bird species have been correlated with standing water levels in other areas of the birds' ranges. Both the Common yellowthroat and the Eastern meadowlark generally have higher breeding densities when climatic conditions indicate low standing water levels during the breeding season (Cody, 1985). Similar information regarding Red-winged blackbird breeding density and water levels was not available. However, since it

commonly forages on the ground, it would follow a similar trend. Summer peaks of breeding Common yellowthroats, Red-winged blackbirds or Eastern meadowlarks were less obvious in 1995 compared to 1994 (Appendix D, Figure 38).

3.11.2 Wading Bird Use

Wading birds were most frequently seen during road surveys. Several wading bird rookeries exist in the eastern portion of WCA 3B (Appendix D, Figure 30). Wading birds appear to locate appropriate areas for foraging quickly, even at distances from roosting sites (Fredrickson and Laubhan, 1994). Average distance traveled daily from a rookery to suitable foraging habitat is approximately 10 km, but may range up to 35 km (Frederick and Collopy, 1988). Water depth appears to be one of the critical determinants for selecting foraging habitat. Smaller egrets and herons (Snowy, Little Blue) most effectively forage in water depths less than 15 cm; larger waders (Great Blue Heron, Great Egret) selectively forage in 15 to 30 cm of water (Fredrickson and Reid, 1986). Species breeding in these rookeries included the Great egret, Green heron, Great blue heron, and Anhinga (Runde et al., 1991).

With the exception of the Great blue heron, herons and egrets preferentially nest in willows. Additionally, most rookeries are surrounded by water, which apparently reduces nest predation by terrestrial mammals and snakes (Frederick and Collopy, 1988). There were only a few suitable willow heads in the Lakebelt study area large enough for a breeding colony. One of these was located at the junction of the Pennsuco Canal and the Dade-Broward Levee. Congregations of Black-crowned night herons were noted during the spring at this site. However it was not clear if a breeding rookery was established.

Great blue herons tend to nest alone or in groups of a few pairs. This species has been reported to nest in melaleuca trees (Frederick and Collopy, 1988). Anhingas have also been reported to nest in melaleuca heads surrounded by sawgrass marshes (Schortemeyer et al., 1981). Nesting attempts in melaleuca trees by Great blue herons or Anhingas were not observed in the Lakebelt study area.

3.11.3 Successional changes in vegetative structure and faunal implications

Melaleuca invasion of native prairies changes the vegetational structure of the landscape. It is unclear to what extent melaleuca invasion also changes the hydrological characteristics of an area. The wildlife study was designed to address only the impact of melaleuca coverage on wildlife diversity and abundance. Prior to the current study, the only information available was based upon either dense melaleuca stands only (Schortemeyer et al., 1981) or were short-term studies that considered only a few species (Mazzotti et al., 1981; Sowder and Woodall, 1985; Repenning, 1986).

As melaleuca coverage increases, a graminoid prairie with low structural diversity becomes a savannah (mix of open prairie and trees) with increased structural diversity.

As melaleuca coverage continues to increase, the savannah becomes a closed canopy forest with sparse understory. Since little understory persists in the forest and most of the trees are of similar size, structural diversity of the forest is lower than existed in the savannah stage of melaleuca invasion. Some animals (e.g. many birds, c.f. Cody, 1985) select habitat based upon subtle differences in vegetational structure. However, other animals (e.g. amphibians and reptiles) are less sensitive to vegetative structure but select habitats based upon other characteristics (e.g. soil or hydrological characteristics; Campbell and Christman, 1982).

The results of the study demonstrated a higher diversity and abundance of birds in the cover types that have moderate levels of melaleuca coverage. As discussed above, these were the cover types with the greatest structural diversity. Notably absent from these areas, though, were resident bird species that are specific about the types of trees they use (e.g. Pine warbler). Many of the transient and winter-resident birds occurred at much lower abundances than in cypress swamps of the Big Cypress National Preserve or the uplands of Long Pine Key, Everglades National Park (GHD, personal observations).

In contrast to the birds, a similar diversity of amphibians and reptiles was found across all cover types. However, their abundances generally decreased in the closed-canopy melaleuca forest (dense melaleuca cover type). The lower abundances indicated poorer habitat quality. This was probably the result of the closed-canopy of the forest limiting the amount of sunlight reaching the water surface. With reduced sunlight, the algae forming the structure of the periphyton mat does not develop. Many species of amphibians and reptiles consume Crayfish, Grass shrimp, and smaller forage fishes that depend upon a well-developed periphyton mat. However, complex patterns of hydrology, and gapping in forest canopy due to wind storms and fires permits light penetration and the persistence of productive pockets of aquatic life even within dense stands of melaleuca. Changes in both structural and wildlife diversity are summarized in Appendix D, Figure 39.

3.11.4 Landscape effects

Melaleuca invasion of a graminoid marsh increases the patchiness of the habitat. An aerial view of the Lakebelt study area reflects the high degree of interspersion of vegetative cover types, particularly north of the Pennsuco Canal and along the southern border (C4 (Tamiami) Canal). Cover types for wildlife sampling and vegetation mapping were defined by percent coverage by melaleuca. The spatial scale on which melaleuca coverage is defined is critical. Shifts in abundance of many plant and wildlife populations relate to the degree of canopy closure as well as hydrology. The impact of seedling or sapling melaleuca, which has little or no canopy, differs from that of mature melaleuca trees with the same percent coverage. It was for this reason that the original cover types were modified to include two coverages of 75% to 100% melaleuca (sapling versus mature).

The mosaic of prairies with low to moderate infestations of melaleuca surrounding mature dense melaleuca stands may allow higher numbers of individuals and species to persist in, or seasonally use, mature dense melaleuca stands. However, this factor was not explicitly considered in sampling. The only variable considered was melaleuca coverage. Random sampling of three replicates of each cover type per month did not permit testing of any variable other than melaleuca coverage. Further studies should address the effect of site location on animal abundance.

While the mosaic of habitats may contribute to the abundance of animals (particularly fishes and semi-aquatic herptiles) in dense melaleuca sites, it is unlikely that the Pennsuco marshes on the western edge of the area were the sole source of fishes and some fully aquatic herptiles (e.g. Greater siren, Two-toed amphiuma). Levees subdivide the Lakebelt study area along both north-south and east-west axis. These levees are dispersion barriers to fishes, and some fully aquatic herptiles. Therefore, some species are confined to isolated sub-basins, which sustain local populations. Abundance of Greater siren in a mature dense melaleuca site isolated from areas with lower melaleuca coverages was a good example of this. The rapid rate at which fully aquatic herptiles and fishes exploited standing water in many sites indicated that deep water or subterranean refugia were available within each of the sub-basins.

3.11.5 Changes in species composition

The number of species (species richness) and the number of individuals (species abundance) are not, by themselves, a good measure of the environmental value of a habitat. Disturbance of natural communities typically results in an increase in species diversity as non-native, migratory and/or species uncommon to the natural community increase in numbers. A typical example of this was increased species diversity in areas with moderate levels of melaleuca coverage. This resulted primarily from native bird species atypical of graminoid prairies using the unnatural habitat created by melaleuca invasion. Which species are using a habitat and the manner is which they use the habitat (foraging, breeding) are more important to final evaluation of habitat quality (Stauffer and Best, 1980; Keller et al, 1993). A fair analysis of habitat quality would evaluate the types of species (e.g. wetland versus upland animals, native versus non-native), as well as their abundances.

As discussed earlier, the loss of wetland species habitat value did not occur until melaleuca density caused canopy closure (e.g. above 75% melaleuca coverage; Appendix D, Figure 36, 37). The point at which the number of species or individuals of non-wetland taxa was equal to the number of wetland taxa was reached at or near Prairie with melaleuca (75%). These graphs also demonstrated the non-linear rate of transition.

It is important to recognize that species categorized as "wetland dependent" or "wetland seasonal" may require dry areas or have a preference for water depth. In fact,

most wetland-associated vertebrate animals are adapted to using water depths of less than 25 cm (Fredrickson and Laubhan, 1994). Species assigned to the same category may have different preferences with regard to timing, depth and duration of flooding. Fredrickson and Laubhan state (p. 645): "No single wetland or wetland type will provide all the resources needed by a single vertebrate during all of its life-history stages or for all vertebrates adapted to wetlands. Thus, wetland complexes are essential for successful management".

There were two principal physical gradients in the Lakebelt Study Area environment: tree density and water levels. Tree density was a geographic gradient, with density varying primarily from east to west. Water level was primarily a temporal gradient, varying with seasonal rainfall.

The dominant characteristic of the faunal shifts along the gradient of increasing melaleuca coverage was increased numbers of upland, arboreal, and, or forest species, not the loss of wetland species. Analysis of the species that are most strongly tied to this gradient indicated that degree of melaleuca cover causes original wetland habitat to become progressively suitable to non-wetland species at a faster rate, than it becomes unsuitable to wetland species. The result is a pattern of increasing species diversity and abundance through the intermediate cover types. Increasing use of areas by savannah and forest birds, and mammals plays a significant role in creating this gradient.

The dominant characteristic of the faunal shifts along the gradient of water level was seasonal variation in abundance of wetland species. The majority of fully aquatic species (the aquatic macro invertebrates, all the fishes, and some herptiles, birds, and mammals) did use habitat with increased canopy cover, primarily as an effect of standing water. The existence of this prey base (invertebrates and forage-sized fishes, in particular) permitted higher consumers to use these habitats.

Canopy closure occurred when melaleuca cover increased beyond 75%. This reduced sunlight penetration to the understory, and therefore reduced primary productivity of the periphyton and submerged macrophytes. This had a dramatic affect on the primary consumers and detritovore macroinvertebrates (e.g. apple snails, crayfish), resulting in overall lower abundance and productivity in the understory. However, complex patterns of hydrology, and gapping in forest canopy due to wind storms and fires permits light penetration and the persistence of productive pockets of aquatic life even within dense stands of melaleuca.

While it has been anecdotally noted in the literature that melaleuca invasion causes secondary increase in ground surface elevation, we observed little evidence of this in the study area. As the previous brief hydrological assessment has pointed out, most sites in the study area were flooded regularly according to existing patterns of rainfall, topography, and water management. Therefore, we have no evidence at this time that the gradients identified in species patterns were due to a ground surface

elevation gradient. The wide variety of upland animals found in the area appeared to regularly use levees, embankments, roadways, naturally elevated spots, and trees as high water refugia.

3.11.6 Percent similarity in species composition

Using the species composition of the Marsh cover type as a standard for comparison for the other designated cover types, the percent of the species for each faunal group in each cover type that was the same as the species found in Marsh was calculated. For fishes and herptiles the four cover types shared between 50 and 70 percent of the Marsh species in common. The mammals showed similarities in species overlap with Marsh from 40 to 65 percent. The birds showed the greatest difference in species composition among cover types, with between 20 and 30 percent overlap in species composition to Marsh (Appendix D, Figure 40).

In general, as melaleuca invasion progressed the fishes and herptiles retained a high degree of constancy in community composition. The fishes and herptiles moved along a gradient primarily dictated by standing water levels. Since the area had a very limited variation in topography, these faunal groups appeared to move in and out of local areas as water levels shift due to variation in topography, regardless of melaleuca density. The birds showed the most dramatic shift from typical marsh inhabitants to progressively greater numbers of forest dwelling species. The mammals showed a progressive change from wetland to upland species as forest cover increased.

The percent of taxa that were found in each of the five cover types varied widely between faunal groups (Appendix D, Figure 41). Eighty percent of the 10 invertebrate taxa trapped by drift fencing were found in each cover type. Only 2 of the 46 birds observed in strip transects were found in each cover type (Common yellowthroat and Palm warbler).

3.11.7 Multivariate analyses of changes in species composition

In order to clarify patterns of species use of the region, a large data set was developed based on the raw data sets. This large data set was constructed as a qualitative data set, i.e. presence/absence data entries (see Appendix D, methods section) of 133 taxa of macroinvertebrates, fishes, herptiles, birds, and mammals. The data set was empirically derived, i.e. it relied on actual recorded observations using standard methods rather than a subjective list of what should or might occur in a cover type. The data set was analyzed by cluster analysis, factor analysis and multidimensional scaling in order to determine what subsets of species best characterized cover types. These subsets drew species from all the taxonomic groups.

Cluster analysis of the 133 taxa's presence or absence in the five cover types using percent disagreement resulted in a tree diagram in which Marsh was first joined by an intermediate grouping of Prairie with melaleuca (50-75%) and Prairie with

melaleuca (50-75%), and secondarily by the more distant grouping of dense melaleuca saplings and dense mature melaleuca (Appendix D, Figure 42).

The same pattern was seen in the plot of the first two principal components of the factor analysis (Appendix D, Figure 43): a curvilinear pattern or gradient from Marsh through Prairie with melaleuca (10-50%) and Prairie with melaleuca (50-75%) to the dense coverages. Overall then, the gradients in community composition that were identified when each faunal group was analyzed separately were also seen when all faunal groups were analyzed simultaneously.

3.11.8 Wildlife Resources Associated with Deep Quarry Lakes and their adjacent Littoral Zone

The wildlife resources utilizing the quarry lakes and their adjacent littoral wetlands were to be surveyed under a DERM contract with NOVA University. The work was unfortunately never completed. However, preliminary surveys found a large assortment of both native and exotic species in the lakes and on the littoral shelves. The native species included largemouth bass (*Micropterus salmoides*), mosquitofish (*Gambusia holbrooki*), least killifish (*Heterandria formosa*), striped mullet (*Mugil cephalus*), flagfish (*Jordanella floridae*), bluefin killifish (*Lucania goodei*), swamp darter (*Etheostoma fusiforme*), sailfin molly (*Pocilia latipinna*), threadfin shad (*Dorosoma penenense*), and a number of sunfish species (*Lepomis* spp.). The exotic species included the myan cichlid (*Cichlasoma urophthalmus*), peacock cichlid (*Cichla ocellaris*), walking catfish (*Clarisa batrachus*), and pike killifish (*Belonesox belizanus*). The survey also documented a well developed macro-invertebrate and invertebrate fauna associated with the littoral shelf, which included crayfish (*Procambaris alleni*), grass shrimp (*Palaemonetes paludosus*), apple snails (*Pomacea* sp.), along with a large assortment of aquatic insects. No quantitative data was developed for these resources.

Field observations of the limited littoral areas within the study area revealed an immature but developing emergent wetland community. The littoral shelves were serving as limited fish spawning habitat, which in turn was being utilized to some extent by wading bird for foraging. Osprey, bald eagle, American anhinga, double crested cormorant, and the American alligator were also observed foraging in the lakes.

If the developing littoral wetlands are protected from physical damage, i.e., wind and wave damage, and appropriate water levels are maintained for their continued development, it would be expected that their wetland functions and values would continue to increase until reaching a fully developed community.

3.11.9 Endangered Wildlife Species

The Wood stork is the only Endangered species observed in the Lakebelt study area. It is listed at both the State and Federal levels. Both adult and juvenile Wood storks were observed foraging in the shallow water impoundments along the Florida Power and Light right-of-way, mitigation areas along the Dade-Broward Levee, and in Prairie with melaleuca (50-75%) cover type. The highest number of individuals observed in one day was 53. These individuals were in a mixed species of flock of more than 300 wading birds foraging along the FPL R/W in April 1995. The closest breeding rookery (1989 data) is located approximately 15 km to the west of the Lakebelt study area, on the eastern border (L67) of WCA 3A (Bancroft et al., 1990; Runde et al., 1991). This colony supported 125 nesting pairs of Wood storks. It also supported Great egrets, Snowy egrets, Tricolored herons, Little blue herons, and White ibis. Total number of active nests was estimated to be more than 2,000 (Bancroft et al., 1990).

3.11.10 Threatened Species

The American alligator was the only species listed as threatened (similarity of appearance) at the Federal level that was observed. The alligator is listed as a Species of Special Concern at the state level (see definition below). It is listed at the federal level due to similarity of appearance to declining populations in the northern part of its range. The alligator was regularly observed in canals. Trails were frequently seen in the Prairie with melaleuca (10-50%) and Marsh cover types. Four individuals that had been killed by gunshot were found. One of the animals had its tail removed. The Least tern is listed at the State level, but does not have any designation at the Federal level was seen on several occasions, foraging above a canal.

3.11.11 Other State Listed Species: Species of Special Concern

The State of Florida designates populations that are not currently Threatened or Endangered within the state yet have shown long term population declines and are considered either vulnerable to exploitation or environmental changes as Species of Special Concern.

Seven species listed as Species of Special Concern have been observed in the Lakebelt study area. These species are: American alligator, Gopher tortoise, Snowy egret, Tricolor heron, Little blue heron, White ibis, and Roseate spoonbill. The American alligator was discussed above under Threatened Species. A single Gopher tortoise was found along a levee. The individual had been marked with paint, suggesting that it had been held in captivity. Suitable habitat for this species does not exist in the Lakebelt study area. The occurrence of this individual is anomalous. The remaining five species of wading birds seasonally forage within the Lakebelt study area.

Traditional breeding rookeries are located to the west of the Lakebelt study area in Water Conservation Area 3A and 3B.

3.11.12 Other Federal Listed Species

The US Fish and Wildlife Service designates species that are considered vulnerable as candidate species. Species for which there is sufficient evidence to warrant either Endangered or Threatened status are designated as C1. Species considered vulnerable yet requiring additional evidence to determine population status are designated as C2. Candidate species are not protected under the Endangered Species Act. However, the USFWS " encourages their consideration in environmental planning" (US FR Vol. 55, No. 35, pp. 6184-6229).

Three species designated C2 have been observed. These species are Gopher tortoise, Island glass lizard, and Loggerhead shrike. The Gopher tortoise was discussed above as a State of Florida Species of Special Concern. The Island glass lizard was trapped on nine separate occasions in Prairie with melaleuca (10-50%) and Prairie with melaleuca (50-75%). This species does not have any designation at the State level. The Loggerhead shrike is a winter resident bird. It was observed in Marsh, within Prairie with melaleuca (10-50%), Prairie with melaleuca (50-75%), dense melaleuca saplings and along levees. This species does not have any designation at the state level.

3.12 Habitat Evaluation

In an effort to evaluate the chemical, physical and biological functions of a site and be consistent with policy considerations as described in Section 10/404 of the Clean Water Act, CEQ Guidelines and COE Planning Guidance, concerning determination of existing wetland values, mitigation requirements from authorized impacts, and present and future value of mitigation sites, a method is needed to assess these functions and values. COE policy states that wetlands will be assessed on their functional capacity. To be legally defensible wetlands evaluations need to be based on concepts of functional equivalency and comparative value that are based on accepted science. A number of assessment methodologies are being developed or are in use in south Florida that achieve this goal. These include the Hydrogeomorphic Functional Assessment Method (HGM) being developed by the COE, Wetland Rapid Assessment Procedure (WRAP) being developed by the SFWMD, and Modified Wetland Rapid Assessment Procedure (M-WRAP) which was modified from WRAP for use by the Mitigation Bank Review Team. These methodologies all incorporate the concepts of the U. S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP).

The purpose of this section is to describe a logical, scientifically based and legally defensible framework for establishing wetland compensation requirements. The framework rests on the simple idea that full compensation for the losses caused by the destruction of existing wetlands can only occur when the environmental and other

values supplied by a restored or created wetland match or exceed those that would have been supplied by the original wetland had it not been disturbed. Approximate compensation, in other words, must ensure that the increase in environmental functions and values resulting from the compensation is sufficient to make up for the decline in functions and values that result from the damage to existing wetlands.

To be sure, the simple idea of comparing wetland functions and values glosses over considerable complexity. Wetlands are valuable primarily because of the streams of varied ecological functions and economically valuable products and services that they provide over time. The value of any given wetland is based on its capacity to provide these benefits, which depends in part on its proximity to other ecological features of the watershed and it's accessibility to humans and other species.

Assessing the adequacy of compensatory mitigation involves a comparison between the stream of wetland functions and values that would occur over time if the original wetland were not disturbed with the stream of functions provided by compensation wetlands. At a basic level such a comparison depends on three critical factors:

(1) The long-term sustained level of wetland function provided by the compensation wetland, as compared to the original;

(2) The speed with which the created or restored wetland reaches a sustained level of function; and

(3) The risk of compensation failure or more generally, the uncertainty about the level of wetland function that the compensation project will provide.

However, a comparison of existing and proposed compensatory wetland values should also depend on decisions about which wetland functions are most or least important. Where multiple functions are employed, a procedure is necessary that allows simultaneous consideration. However, no matter how the functions are assigned and tradeoffs are made between wetland functions, the logical foundation for estimating appropriate compensation is the same. They should be based on a comparative analysis of the streams of functions and values gained and lost.

The methodology used in this planning document is based on the best professional judgment of a group of professional biologists as the evaluators. It utilizes the holistic concepts of HEP to evaluate wetlands, and their interactive associations. However, instead of using a number of individual species models to perform the evaluation at the species level, a functional matrix was developed to assess the study area at the wetland community level.

In establishing a base condition against which alternatives could be evaluated, the USACOE, working with the Lakebelt Environmental Review committee, developed a

cover type assessment matrix of 10 functional parameters (Table 3.12-1) to evaluate the 19 cover types delineated within the Lakebelt study area. The evaluation is patterned on the HGM and WRAP evaluation procedures. However, the Functional Index (FI) for the procedure was determined by a group of professional biologists in the following way. The matrix, along with the vegetation analysis (**Appendix C**) and the wildlife data analysis (**Appendix D**) was sent to a group of professional biologists familiar with South Florida ecology for their evaluation and scoring. This approach established functional indices for comparing the condition of different cover types being assessed against a regional reference standard.

The regional reference standard for this evaluation is a wet prairie (marsh; Dalrymple, 1995) based upon both historical and existing hydrological conditions. The term prairie will be used throughout this document to be consistent with the terminology used in the vegetation report (EAS Engineering, 1995 & 1997). This cover type represents the modern historic condition before anthropogenic activities or invasion by exotic plant species. Prairie wetlands in northwest Miami-Dade County that exhibit the characteristics associated with a pristine wetland shall be given a regional reference standard of 1. All cover types within the Lakebelt study area will be evaluated against this reference standard and given a score between 0 and 1, except for canals, quarry lakes (open water) and littoral zones. The quarry lakes and littoral zones will be evaluated against a subtropical lake and littoral zone (reference standards) that one would expect to find in south Florida. The lakes and littoral zones will be treated as two separate habitats for this evaluation. The littoral zone will constitute a band around the lake that extends upland 10 feet from the edge of the water. From this upper boundary the zone will extend out 50 yards into the lake past the littoral shelf drop off. This littoral band would than encompass the vegetation zone at the upper boundary, the littoral shelf, and the drop off area along the edge of the littoral shelf. The open water lake habitat constitutes the area inside the littoral band. This area is approximately 60 feet deep. Willow Heads, Tree Islands and Pond Apple will be evaluated against a reference standard that represents a theoretical 1 for these cover types.

The scores for any given cover type could range from 0.0 to 1.0. The evaluators were instructed to use the supplied information and their best professional judgment in completing the matrix. The ten functional parameter scores for each cover type were simply weighted equally, and averaged to derive a FI value for each cover type. Using the FI scores of each of the evaluators, the median FI value was determined for each cover type. The median FI value for each cover type was used as the final FI value. The evaluator's functional index matrices for each cover type are on file with the USACOE, Jacksonville District.

Table 3.12-1 Functional Index Matrix

Function	Score
Habitat For Wetland Dependent Species	
Support of Food Chains	
Support of Native Plant Populations	
Presence of Exotic/Invasive Species	
Protected Plant Species - State and Local	
Provision of Landscape Heterogeneity	
Access to Refugia during seasonal Water Fluctuation	
Ability to Perform Water Quality/Flood Storage Function	
Support of Soil Processes	
Support of Hydrologic Regimes	
Total Score	
Cover Type Functional Index* (FI)	

* The Functional Index value is the average of the total score.

A definition of Wetland Functions used in the functional value matrix is as follows:

1 - Habitat for Wetland Dependent Species: Maintains density and spatial distribution of vertebrates and invertebrates utilizing wetlands for food, cover, resting, reproduction, etc.

2 - Support of Food Chain: Does the cover type support the food chain at different trophic levels, ranging from primary consumers of detritus, algae and vegetation, through intermediate trophic levels such as predators on crustacea and aquatic insects, to top level carnivores such as piscivores and/or birds, etc.

3 - Support of Native Plant Populations: Does the cover type provide the important functions for other types of organisms ranging from structure for habitation, to primary production of food, and refuge and escape cover for animals. Creates microclimatic conditions that support completion of life histories of native plants and animals. Provides organic matter for soil development and soil-related nutrient cycling processes. Creates both long term and short term habitat for resident and migratory animals.

4 - Presence of Exotic/Invasive species*: The degree to which the cover type is affected by exotic/invasive species.

5 - Protected Plant Species - State & Local**: The ability of the cover type to provide habitat for protected plant species.

6 - Provision of Landscape Heterogeneity: The association between varying wetland habitats and between wetlands and uplands maintains high levels of biological diversity.

7 - Access to Refugia during Seasonal Water Fluctuation: Aquatic refugia are an important component of wetland ecosystems. During low water levels the cover type should act to retain wetland faunal components while conversely providing a concentrated food source particularly for wading birds. Upland refugia are also important during high water events for the retention of the mammalian fauna of the area.

8 - Ability to Perform Water Quality/Flood Storage Function: Does the cover type function to remove imported nutrients, contaminants, and other elements or compounds? Does the cover type retain its ability to store floodwaters?

9 - Support of Soil Processes: Will the cover type continue to support the soil processes?

10 - Support of Hydrologic Regimes: The capability of a wetland to maintain appropriate hydrology. The source of water is from overland flow, precipitation, and/or lateral groundwater flow. Improves down gradient water quality; maintains baseflow; maintains seasonal flow distribution; lowers the annual water yield; recharges the superficial groundwater.

* - Score of 1 (no exotic/invasive species), score of 0 (100% exotic/invasive species).

** - Supports or provides the opportunity to support = 1.

Table 3.12-2 presents the functional index raw scores of the evaluators, the mean of these scores, and the median value which is used as the final FI value. The evaluators are listed as follows in alphabetical order (note: the order in which they are listed here does not reflect their response positions within the table): Joan Browder, National Marine Fisheries Service; George Dalrymple, Everglades Research Group, Inc.; Nancy Dalrymple, Everglades Research Group, Inc.; Steve Davis, South Florida Water Management District; Ron Hofstetter, University of Miami; Mark Kraus, National Audubon Society; Frank Mazzotti, University of Florida; Bill Porter, U.S. Army Corps of Engineers; Brad Reick, U.S. Fish and Wildlife Service; and Joel Trexler, Florida International University.

Table 3.12-2 Functional Index Values

COVER TYPE	EVALUATORS										Mean	Median
	1	2	3	4	5	6	7	8	9	10		
Agriculture	0.17	0.00		0.43	0.14		0.11	0.25	0.45	0.17	0.22	0.17
Dense Melaleuca	0.14	0.10	0.40	0.59	0.40	0.58	0.44	0.60	0.40	0.54	0.42	0.42
Dense Melaleuca Saplings	0.11	0.30	0.40	0.59	0.48	0.58	0.28	0.59	0.45	0.43	0.42	0.44
Developed Lands	0.13	0.00		0.06	0.06	0.00	0.01	0.07	0.13	0.12	0.06	0.06
Disturbed (Forested & Open)	0.50	0.50	0.50	0.52			0.24	0.21	0.28	0.70	0.43	0.50
Disturbed Prairie	0.56	0.50	0.70	0.72	0.90	1.00	0.68	0.69	0.66	0.65	0.71	0.69
Disturbed Prairie w/ Melaleuca (10-50%)	0.68	0.50	0.50	0.70	0.78	0.92	0.66	0.65	0.63	0.86	0.69	0.67
Disturbed Prairie w/ Melaleuca (50-75%)	0.45	0.30	0.30	0.66	0.63	0.76	0.48	0.63	0.60	0.71	0.55	0.62
FPL Transmission Corridors	0.56	0.10		0.96	0.44	0.87	0.64	0.70	0.78	0.63	0.63	0.64
Lake Perimeter							0.01			0.06	0.04	0.04
Other Water	0.22	0.10		0.70	0.66		0.20	0.30	0.31	0.42	0.36	0.31
Prairie	0.86	1.00	1.00	0.98	1.00	1.00	0.98	0.98	0.95	0.89	0.96	0.98
Prairie w/ Melaleuca (10-50%)	0.76	0.50	0.90	0.96	0.88	0.92	0.96	0.96	0.90	0.86	0.86	0.90
Prairie w/ Melaleuca (50-75%)	0.55	0.30	0.70	0.90	0.73	0.76	0.63	0.90	0.80	0.71	0.70	0.72
Tree Islands	0.56	1.00	1.00	0.95	0.91		0.64	0.92	0.90	0.87	0.86	0.91
Willow Heads	0.83	1.00	1.00	0.95	1.00		0.65	0.94	0.95	0.87	0.91	0.95
Pond Apple							1			0.84	0.92	0.92
Canals	0.49	0.10		0.34	0.41	0.37	0.24	0.37	0.44	0.21	0.33	0.37
Lakes (Open Water)	0.42	0.00	0.30	0.21	0.33	0.12	0.28	0.21	0.14	0.15	0.22	0.21
Littoral Zone	0.66	0.10	0.50	0.89	0.79	0.52	0.69	0.71	0.49	0.30	0.57	0.59

The existing value of each cover type is expressed in Habitat Units (HU's). HU's for each cover type are calculated by multiplying the acreage of the covertype by the functional index value. Table 3.12-3 presents the results of these calculations in habitat units for each cover type.

Table 3.12-3 Existing Habitat Values by Covertypes

COVER TYPE	FI	ACRES	HU's
Agriculture	0.17	3,336.56	567.22
Dense Melaleuca	0.42	11,923.10	5,007.70
Dense Melaleuca Saplings	0.44	6,642.83	2,922.85
Developed Lands	0.06	1,771.18	106.27
Disturbed (Forested & Open)	0.50	2,627.02	1,313.51
Disturbed Prairie	0.69	19.10	13.08
Disturbed Prairie w/ Melaleuca (10-50%)	0.67	414.39	277.64
Disturbed Prairie w/ Melaleuca (50-75%)	0.62	216.81	133.34
FPL Transmission Corridors	0.64	718.87	460.08
Lake Perimeter	0.04	1,666.91	58.34
Other Water	0.31	542.66	165.51
Prairie	0.98	12,598.69	12,346.72
Prairie w/ Melaleuca (10-50%)	0.90	5,065.26	4,558.73
Prairie w/ Melaleuca (50-75%)	0.72	4,220.22	3,038.56
Tree Islands	0.91	346.07	314.92
Willow Heads	0.95	25.78	24.49
Pond Apple	0.92	14.82	13.63
SUBTOTAL		**52,150.27**	**31,322.59**
Canals	0.37	438.96	162.42
Lakes (Open Water)	0.21	4,926.22	1,034.51
Littoral Zone	0.59		
SUBTOTAL		**5,365.18**	**1,196.92**
TOTAL		**57,515.45**	**32,519.52**

* Note: Lakes only have value if they have associated littoral zones.

3.13 Land Use

This section of the PEIS is the result of the land use planning evaluation report conducted by Miami-Dade County, the report is contained in this PEIS as **Appendix E**. The primary purposes of the report are to 1) identify ownership patterns, land use, zoning, and limestone quarrying permits in the Lakebelt area and 2) identify constraints and planning opportunities for consideration in the development of a future Lakebelt Plan. The information contained in this report is summarized according to six geographical units (Figure 8). The units consist of the C-9 Basin, the Transitional Northeast Everglades Basin, the Pennsuco Wetlands Basin, the North Trail Basin, the

northwest four square miles of the Bird Drive Everglades Basin, and the lands south of Tamiami Trail and west of Krome Avenue. For each unit the following information is discussed in **Appendix E**: land use designation and zoning, land ownership and parcelization, existing land uses, land use conflicts and problems, potential future land use conflicts or issues, and recommendations

3.13.1 C-9 Basin

This is a part of the larger 98 square mile C-9 Basin which extends east to Biscayne Bay and north into Broward County. The approximately eleven square mile portion of the C-9 Basin that is included within the Lakebelt area is also called the Snake-Creek Basin in the Comprehensive Development Master Plan (CDMP) for Metropolitan Miami-Dade County. This area is located outside of the Urban Development Boundary and is designated as Open Land on the Land Use Plan Map in the CDMP. The land uses that may be approved in this area include rockmining and related uses, agriculture that requires no additional off-site drainage, rural residences at a density of one unit per five acres, necessary institutions and public facilities, utility and communication facilities and recreational uses. With the exception of four parcels that are zoned IU-3, BU-2 and BU-3, the area is zoned for agricultural or general use. Rockmining is an allowable use in either the general use or agricultural zoning category.

Consistent with the designated land use and zoning, this area is mainly used for rockmining and agricultural uses. Since 1984, Miami-Dade County Department of Environmental Resources Management has issued ten rockmining permits to excavate 2,078 acres in the C-9 Basin. As of December of 1995, approximately 710 acres were excavated. There are also several ancillary facilities such as an asphalt recycling plant, concrete-batching plants, a rock crushing plant and vehicle repair associated with the rockmining facilities.

Rockmining interests own or control about half of the total acreage in this basin. Most of the area that is owned by rockmining interests is in parcels that are greater than 160 acres. Miami-Dade County owns about 400 acres at the Opa Locka West Airport that is used for training and as a landing strip by Metro Miami-Dade Police Department. The State of Florida owns 438 acres in Section 5, Township 52 South, Range 40 East; (14) percent of the land in this Basin is publicly owned. Agricultural uses in the C-9 Basin include cattle and goat grazing, horse stables, tree farming, sugarcane farming and several container nurseries.

Figure 8 Land Use Map

3.13.2 Transitional Northeast Everglades Basin

The largest segment of the Lakebelt is the Transitional Northeast Everglades (TNE) Basin, or Northwest Wellfield Open Land Subarea as it is called in the CDMP. Since this area is located outside of the Urban Development Boundary, the land uses that may be considered in this 33 square mile area are rockmining and ancillary uses, necessary public institutional uses, utility and communication facilities, agriculture that requires no additional off-site drainage and rural residences at a maximum density of one dwelling unit per five acres. Most of this area is undeveloped and zoned for general or interim use (GU). About four square miles in the northern part of the TNE are zoned for agriculture. Rockmining companies own all of these sections, but only about 320 acres are being used for agriculture (i.e. grazing). There are three parcels zoned for industrial uses in the TNE; two of which are on lands owned by Rinker. The third is a vacant 15 acre parcel in the extreme SE corner of Section 36, Township 53 South, Range 39 East. The dominant existing land uses are rockmining and ancillary uses such as a cement mill, concrete batching plants, a concrete block plant, a pre-cast facility, rock crushing plants and vehicle repair facilities.

Major non-rockmining uses in this area are the Northwest Wellfield and wellfield conveyance canal, a Florida Power & Light substation and 500kv transmission line, the South Florida Reception Center and the Metro West Detention Center on NW 41st Street, and two railroad spurs. Other non-rockmining uses include a radio tower, plant nurseries, a fat rendering plant and the remnants of a shanty town in Section 36 of Township 53 South, Range 39 East.

3.13.3 North Trail Basin

The smallest segment of the Lakebelt is the western portion of the North Trail Basin. The lands bordering the western side of NW 137 Avenue are within the Urban Development Boundary and designated for restricted industrial and office use on the CDMP Land Use Plan Map. The remainder of the area is part of Open Land Subarea 3, which is referred to as the Tamiami-Bird Canal Basins in the CDMP. The land uses that may be considered for approval in this 2+ square mile area are essentially the same as those listed for the C-9 Basin.

Most of the western North Trail Basin is undeveloped and zoned for general, or interim use (GU). One 250 acre parcel located west of NW 137 Avenue in Section 3, Township 54 South, Range 39 East is zoned for Agriculture, and two parcels on the west side of NW 137 Avenue in the same Section are zoned and used for legally non-conforming industrial uses. There is currently no rockmining in the North Trail Basin.

3.13.4 Bird Drive Everglades Basin

The northwest four and one half square miles of the Bird Drive Everglades Basin are included in the Lakebelt area. Like the North Trail Basin, this is part of Open Land Subarea 3, Tamiami-Bird Canal Basins in the CDMP. The land uses that may be considered in this area are essentially the same as those listed for the C-9 Basin. Most of this area is undeveloped and zoned for general or interim use (GU). One six acre parcel located at the junction of Krome Avenue and the Tamiami Trail in Section 06, Township 54 South, Range 39 East is zoned BU-3 and used for a fast food/truck stop.

3.13.5 Pennsuco Wetlands

The Pennsuco Wetlands Basin, called the Dade-Broward Levee Basin in the CDMP, covers more than 20 square miles between the Dade-Broward Levee and Krome Avenue. Unlike the other basins in the Lakebelt, all of this area is designated for Environmental Protection in the CDMP. Therefore, new uses that may be permitted are limited to rural residences at a density of one unit per five acres, low-coverage communications facilities, recreational facilities, and necessary public facilities, including water management facilities. With the exception of the southeastern portions of Sections 17 and 19, Township 52 South, Range 39 East, which are zoned for agriculture, the rest of this Basin is zoned GU for general or interim use.

There are about two and one half square miles of land in government ownership and about six square miles owned by rockmining companies in the Pennsuco. All of the government and rockmining lands are in relatively large parcels, as is most of the remaining privately owned lands in this Basin. However, about three square miles in private ownership are subdivided into five and ten acre parcels. Sixty percent of this Basin is in private ownership.

Since 1984, DERM has issued two permits to fill wetlands in the Pennsuco wetlands for antenna facilities. An additional permit was issued to excavate the NW Wellfield.

3.13.6 Lands West of Krome

There are ten square miles south of the Tamiami Trail and west of Krome Avenue that are included within the Lakebelt planning area. The area designated Everglades National Park Expansion Area on Appendix E, Figure 1 is included in this discussion on the Lands West of Krome. In the Everglades National Park Expansion Area the National Park Service currently holds title to approximately two square miles of this area; these lands are regulated according to the policies and plans of Everglades National Park. Like the North Trail and Bird Drive Everglades Basins, the eastern portion of this area is part of Open Land Subarea 3, Tamiami-Bird Canal Basins in the CDMP. Therefore, land uses that may be considered are essentially the same as those listed for the C-9 Basin. New uses that may be permitted are limited to rural residences

at a density of one unit per five acres, low-coverage communications facilities, recreational facilities, and necessary public facilities, including water management facilities. All of this area is zoned GU for general or interim use.

The five square miles west of Levee 31N are designated for Environmental Protection in the CDMP. These lands lie within the authorized expansion area of Everglades National Park. Land uses in this area are regulated by Miami-Dade County's East Everglades Area of Critical Concern program and regulations. Allowable land use density in this area is one dwelling unit per 40 acres.

The analysis that follows refers only to the five square miles east of Levee 31N and west of Krome Avenue, because uses are very restricted west of the levee. According to the property tax records, there are five parcels with assessed building value. None have homestead exemptions, bedrooms or baths. The total assessed value of the taxed structures in this basin is $3,076,447. Most of the buildings in this area are tax exempt governmental facilities such as the Krome Detention Center, the Everglades Correctional Facility and Miami-Dade County jail (under construction), the Miccosukee Tribe Smoke Shop, an FAA Doppler Radar facility, and the U.S. Army NCS antenna facility.

Rockmining companies own three of the five square miles of land in the area east of Levee 31-N. As of 1996, 403 acres had been mined in Sections 24, 35, and 36, Township 54 South, Range 38 East.

3.14 Hazardous and Toxic Wastes

Environmental Data Resources, Inc. under Contract to USCOE, Jacksonville, conducted a data base search. The HTRW Location Map, figure 9 shows the location of the recorded sites within the study area. The northern end of the study area contains the Okeechobee Road corridor with its gas stations and light to heavy industries with their associated underground storage tanks. In this area is also located the Opa Locka West airport and a state licensed landfill.

The central third of the Lakebelt area contains a small number of sites associated with the mining industry, e.i., under ground storage tanks and industrial waste permits.

The southern third of the study area contains a large number of sites associated with the heavily developed southeast corner and along the Tamiami Trail (USHWY 41). This area contains residential development with its gas stations and attendant under ground storage tanks. Light industry with industrial waste permits and under ground storage tanks and the mining industry with its industrial waste permits and under ground storage tanks.

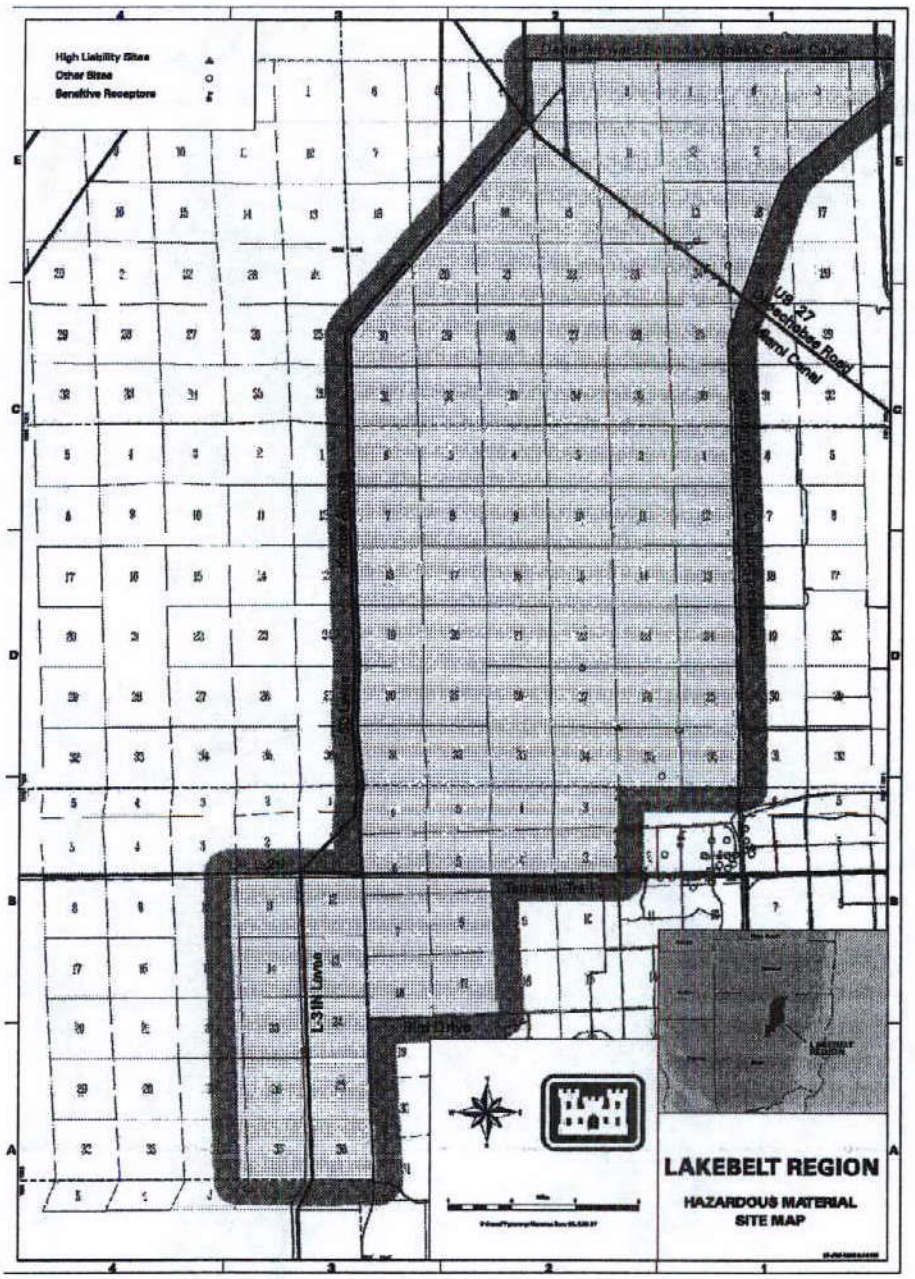

Figure 9 HTRW Map

3.15 Cultural Resources

Native American groups have inhabited Florida for at least 14,000 years. A number of cultural resources investigations in south Florida demonstrate that the project area is rich in historic properties. Some of those investigation results are summarized below.

An archeological survey was conducted by the Archaeological and Historical Conservancy, Inc. in 1994 on the Blockbuster Parcel, Broward and Miami-Dade Counties, a portion of which is included in the Lakebelt project area (Archaeological and Historical Conservancy, Inc. 1994). Seven pre-Columbian archeological sites were recorded during the survey, all habitation sites are on tree islands or low sand ridges. Three of the sites were determined eligible or potentially eligible for inclusion on the National Register of Historic Places, and although no human remains were encountered during the survey, these three sites were determined to have the potential to contain human burials.

An additional cultural resources survey was conducted along a portion of State Road 90, Tamiami Trail from S.W. 152nd Avenue to S.W. 127th Avenue (Janus Research 1995). This survey examined archeological site DA33, a black earth midden that is bisected by Tamiami Trail. The site was determined to be eligible for inclusion on the National Register, although the portion of the site within the Tamiami Trail right of way has been so badly disturbed by road construction and use that it no longer contributes to the site's eligibility.

A countywide survey was conducted in Miami-Dade County (Carr and Rodriguez 1981), recording 27 potentially significant archeological sites in the Lakebelt project area. The survey was not comprehensive or intensive, and additional potentially significant historic properties may be discovered in areas that have not been subjected to a systematic, professional survey to locate such properties.

3.16 Air Quality

Existing air quality in the affected environment is good to moderate except for the air pollutant ozone. Based on ten years of monitoring data, the national ambient air quality standard for ozone is periodically exceeded in the eastern urbanized coastal part of Palm Beach, Broward and Miami-Dade Counties. The Lakebelt study area is situated between urbanized Miami-Dade County to the east and the Everglades to the west. All of Palm Beach, Broward and Miami-Dade Counties are classified by the DEP as Ozone Attainment/Maintenance Areas (i.e. meets all federal standards currently).

Short-term occurrences of elevated levels of airborne particulate matter could occur periodically in the project area due to natural fires and limestone mining activities. Air pollution from the urbanized coastal area is also expected to affect the air quality of the project area. Existing major stationary sources in the south Florida area include an oil-fired power plant at Fort Myers (West Coast), oil-fired power plants and municipal waste incinerators in the eastern coastal areas of Palm Beach, Broward, and Miami-

Dade Counties, sugar cane processing mills near Clewiston and Belle Glade and a portland cement plant in western Miami-Dade County. I-75, U.S. 41 and a number of secondary roads bisect the study area and support significant vehicle traffic. For example, approximately 3,000 vehicles cross I-75 each day in each direction. Vehicle emissions are not significant, but contribute to air quality of the area.

The East Coast urbanized area of Miami-Dade, Broward and Palm Beach Counties has a population of approximately three million people. The prevailing southeast winds carry emissions from the metropolitan areas and regional oil-fired power plants and waste incinerators into the project area. Regional haze and smoke plumes attributed to the power plants and sugar cane burn off have been observed in the adjoining Everglades area. Observations from Miami and Fort Lauderdale International Airports indicate a typical visual range of 10 to 15 miles.

The flat coastal and inland terrain, in combination with diurnal changes in temperature, land - sea breeze recirculation, and frequent south Florida afternoon thunderstorms, constantly alters the surface air flow over the Lakebelt area and provides for continuous air movement and circulation. These factors provide good dispersion rates. No areas or periods of prolonged or poor dispersion are expected in the affected environment.

The Lakebelt project area has been designated in the Clean Air Act (42USC,7472) as a Prevention of Significant Deterioration (PSD) Class II area for all EPA regulated air pollutants except ground level ozone. Industrial development is allowed within such areas provided the release of air pollutants associated with such development complies with the requirements of Ambient Air Quality, PSD, and Non-attainment New Source Review standards.

PSD Class I areas, including wilderness areas established prior to the enactment of the Clean Air Act in 1977, and national parks, have more stringent standards than the PSD Class II areas. Everglades National Park is designated as a Class I area.

3.17 Aesthetic Resources

Aesthetic resources is the term used to describe the physical characteristics of a landscape that determine its scenic quality in relevant value to the viewing public. These characteristics are frequently described by using basic design terms such as: form, texture, and pattern; and by actual reference to natural features in the environment (vegetation, water, ecological, formations, soils, etc.) that make up a specific landscape scene as viewed from various perspectives.

The landscape of the Lakebelt area has been altered by excavation of canals and quarry lakes, construction of levees and roads, hydroperiod disruption, and invasion of exotic plant species. In spite of the altered condition of the study area, the average viewer could judge the landscape character as generally "natural".

The Lakebelt study area may be characterized as a landscape unit or scenic quality-rating unit (U.S. Forest Service and Bureau of Land Management terminology) of wet prairie w/melaleuca stands. The overall visual variety within this landscape unit is minimal with little or no diversity. This perception of minimal diversity results not only from the subtle differences in landscape form, color, and texture, but is also a result of the dynamic mode of the average observer (from an automobile). The natural appearing landscape remains dominant. Changes in the landscape are evident, i.e., quarry lakes, but not dominant.

3.18 Noise

The vicinity of the proposed action (Lakebelt area) is rural in character consisting of agricultural, undeveloped lands, quarry lakes, and industrial infrastructure associated with the limestone mining activities. Residences are confined primarily along the east and northeastern boundaries of the project area.

Existing sources of noise outside of the urban communities are limited to vehicles that travel on I-75, U.S. 41 and rural roads. Several limestone milling and mining operations, and farm equipment, which is operated within the Lakebelt area are additional sources of noise.

Noise measurements are not available for the project area. Rural, undeveloped sites have typical noise levels of 35-55 dB. Sound levels along transportation arteries are typically in the range of 70 dB.

Noises associated with the current activities are not expected to extend beyond the immediate project area.

3.19 Recreation

The existing recreational opportunities within the Lakebelt area are limited. A discussion by basin is provided.

C-9 Basin - There are several places which rent or board horses and ponies in the rural, agricultural portion of the C-9 Basin. On weekends, this area is heavily used for horseback riding.

Transitional Northeast Everglades Basin - Although access into this area is quite limited, some of the rockmining lakes are used for fishing. The major recreational facility in the TNE is the County's M.E. Thompson Park, which is open about six months of the year during the dry season and is used as a camping area, mostly by fishermen. There is also a private trailer camping facility located northeast of M.E. Thompson Park, on the Miami Canal. Besides using this area for fishing, the people who reside in and visit these parks use the FPL right of way and canal rights of way for biking.

North Trail Basin - Because access into this area is quite limited, there are very few legal recreational uses at this time. Like the western four square miles of the Bird Drive Basin, this area experiences a plethora of illegal uses during the dry season.

Bird Drive Everglades Basin - Access is generally limited to trucks, four-wheel drive and all terrain vehicles. During the dry season the area is plagued by dumping, ATV use, shooting, paint ball, car stripping and other illegal uses.

Pennsuco Wetlands Basin - The County's Trail Glades Range in the SW corner of the Pennsuco is heavily used by Metro Miami-Dade Police Department and others for target practice. The surrounding dense stand of Melaleuca provides an excellent sound and visual buffer, but it also is a major seed source for this exotic pest plant. Removal of these trees within the gun range may be very problematical and costly, because of the lead and the need for an adequate buffer around this facility.

3.20 Socio-Economics

The mining and processing of crushed limestone is an important source of jobs and income for those employed directly in these activities in addition to those indirectly employed. The mining of crushed stone within the United States is a significant industry both as a means of employment and as a producer of needed products. In 1997 the Florida crushed stone mining industry mined more than 70 million tons. The quantity of crushed limestone mined in the Lakebelt region of Miami-Dade County is approximately half of total state production. The annual rate of growth of limestone mined from the Lakebelt is 6.5% per year for the period 1993 through 1997. This rate of increase in tons of limestone mined is keeping pace with the dynamic growth of Florida.

The rock mined in the Lakebelt region is used for five primary purposes; asphalt aggregate, concrete aggregate, road base, fill, and cement. Approximately one-half of the limestone mined is used for concrete aggregate. Generally speaking, concrete is used in building infrastructure. Most of our urban environment is built with concrete. The limestone mined from the Lakebelt is shipped by rail to as far north as Jacksonville. The Orlando area is also supplied by Lakebelt rock. Thus the limestone mined in this western part of Miami-Dade County has statewide significance first in the high portion of total state production accounted for by this small area and second in terms of the portion of the rapidly growing state that derives limestone products from this region. Between 1980 and 1990 the state saw the addition of more than 3 million people to its population. After 1990 the pace of growth slackened due to the recession of the early 1990's but since economic recovery annual growth has returned to the 300,000 per year range. Approximately 80% of Florida's growth in population is due to net in-migration. From 1980 to 1990 Florida added 1.7 million new housing units. Since 1990 the average pace of new construction has been 100,000 per year. As with population growth, the pace of construction slowed during the recession and since recovery is now running at a pace of some 125,000 housing unit starts per year. In addition to the

homes, millions of square feet of nonresidential construction have been built to provide places for employment, commerce and recreation for the great number of individuals present. Lastly, the state has been adding approximately 1,000 new miles of roads per year. All of this growth requires limestone in order to be accommodated. The most significant impact of Lakebelt crushed limestone mining is the production of goods, primarily building goods, for a growing Florida.

The development of Florida has transformed a small and economically deficient state into what will become the third largest state (after California and Texas) and one of the more economically prosperous. At the outset of this century Floridians were among the nation's poorest, with state per capita income at 55% of the nation norm. By 1996 Florida per capita incomes had grown to equal that of the national norm. This rapid growth has been the most significant factor in the demand for crushed limestone and products made from crushed limestone. The significance of the crushed limestone industry of the Lakebelt goes far beyond its local production, for it plays a vital role in the economic development of the state. Additionally, this region of the United States is playing an increasing role in national and international economic development. Therefore, the significance of the Lakebelt crushed limestone industry extends to national and international considerations. A detailed discussion of the economic significance of Lakebelt mining activities and products refer to **Appendix G**

3.21 Northwest Well Field

The Northwest Wellfield is owned and operated by the Miami-Dade Water and Sewer Department (MDWASD). The wellfield is located in Sections 11 and 14 of Township 53S and Range 39E, in Miami-Dade County (the MDWASD also owns Section 12). The wellfield consists of fifteen (15) 48-inch diameter wells. The wells were drilled to a total depth of 80 ft and cased to a depth of 46 ft. Each well has a variable speed pump rated at a design capacity of 10 and 15 million gallons per day (MGD). The total withdrawal capacity is approximately 150 to 225 MGD.

The wellfield was initially permitted in 1975 with an allocation of 50 MGD for average day and 87.5 MGD for maximum day. The construction permit was issued by the State in 5/14/81 with a pumpage capacity of 225 MGD. The wellfield was constructed at a cost of $50 million. The current permit was issued on 3/14/91 with an allocation of 164.93 MGD average day and 197.91 MGD for maximum day. The permit is for all the wellfields supplying the Hialeah/Preston Water Treatment Plants. A permit modification was submitted on 6/13/94 requesting an allocation of 210 MGD for average day and 241.6 for maximum day. This application was recently modified to request a maximum day allocation of 225 MGD, limited to a maximum day allocation of 165 MGD from the Northwest Wellfield. The MDWASD is proposing to construct to Aquifer Storage and Recovery (ASR) wells in this wellfield.

Miami-Dade County currently has a wellfield protection plan establishing a buffer zone to protect against septic tanks and hazardous materials, however, it may be

inadequate protection against surface water contaminants such as *Giardia* and *Cryptosporidium*. These organisms can be deadly to people with compromised immune systems and can cause illness to the general public. Neither of these organisms have been detected in Dade County's water supply. Present Miami-Dade County Code prohibits mining within a travel time of 60 days from any public utility water supply well. However, the code allows mining up to a travel time of 30 days provided the excavation does not exceed a depth of 40 ft.

U.S. Environmental Protection Agency mandated the State of Florida to determine which ground waters are under the direct influence of surface waters (GWUDI). The FDEP sampled various MDWASD wells in December 1995 and October 1996. From this sampling program, they determined that well no. 10 at the Northwest Wellfield was GWUDI. Based on this determination, the MDWASD had to do one of the following:

- Notify the public that the water does not meet standards.
- Shut down well no. 10.
- Modify the treatment plant process (within 18 months) to provide the required surface water level of treatment. The treatment process changes (additional filtration and disinfection) required to comply with present regulations will cost $230 million.

The MDWASD shut down well no. 10, conducted an evaluation of the well integrity and is in the process of rehabilitating the well, to minimize surface water influences. In addition, the MDWASD is entering into an agreement with the FDEP (approved by the Board of County Commissioners on 2/3/98) to evaluate all the water supply wells and proceed with rehabilitation if the sampling indicates a potential for GWUDI. The cost of this program is estimated to be $15 million, out of this cost $1.5 million will be spent at the Northwest Wellfield.

The monitoring data collected (by MDWASD and FDEP) since December 1995 indicate that the most northern wells (closer to existing lake) have more influences from surface water. In the FDEP Agreement, the FDEP has agreed to clear wells nos. 1,2,3,5,6,7,8,9,11, and 12; well no. 4 needs additional monitoring (because not enough sampling has been conducted); and wells 10, 13, 14 and 15 (the northern most wells) are subject to investigation/rehabilitation. The cost of the GWUDI investigations conducted as of today, at the Northwest Wellfield only, is $550,000.

Implementation of the FDEP Agreement could solve the current GWUDI determination, however, the proposed Lakebelt Plan will mine the existing buffer between the Northwest Wellfield and other surface waters. At this time, it has not been determined what is needed as a safe buffer to protect the water supply. The Lakebelt Buffer Subcommittee is currently conducting a study to evaluate this buffer. However, this information might not be available until the completion of the Phase II Master Plan in December 2000.